

# JOURNAL

Heating • Refrigerating • Air Conditioning • Ventilating

APR 10 1961

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AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS

*What About 25 Years From Now  
In The Heating Industry?* page 41

*Sizing Refrigeration System Pipelines  
For Optimum Economy* page 42

*Ways To Calculate  
Incident Low Temperature Radiation* page 51

*Design And Performance  
Of Evaporative Condensers* page 55

*Pipe And Pump Size Reduction  
With Medium Temperature Water* page 60

*Integrated Time And Temperature  
As Affects Frozen Food Quality* page 66

APRIL 1961

**NEW CONDENSER WATER  
REGULATING VALVE**

# NEVER CHATTERS

**A-P MODEL 65A IS SMALL  
FOR EASY INSTALLATION . . .**

**\*FEATURES SELF-CLEANING  
ORIFICE FOR RELIABLE OPERATION  
EVEN IN DIRTY WATER**

The A-P model 65A eliminates chatter because it is not affected by inlet pressure variations... a unique design feature of the 65A valve in regulating water flow to condensing unit by head or condenser pressure.

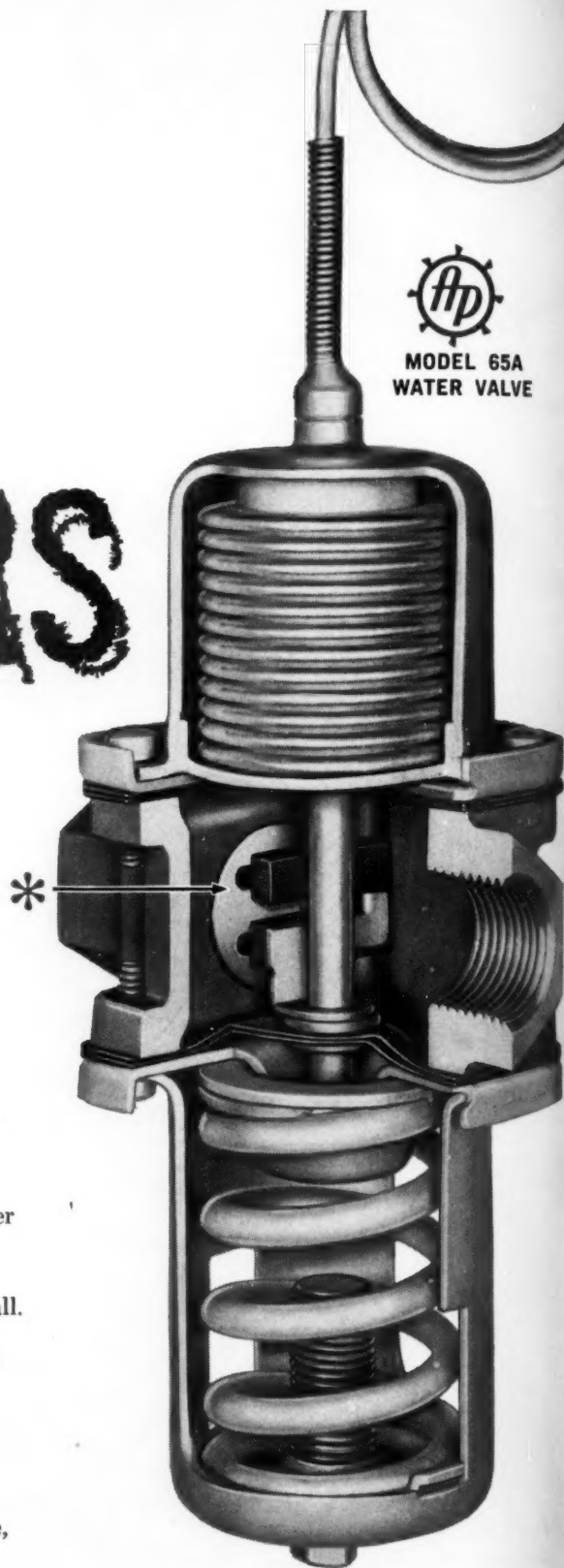
The model 65A cleans itself as it operates. A Graphitar sliding block — the only moving part in water — wipes over the orifice in the stainless steel facing plate. Provides trouble-free service even in dirty water.

Compact size makes the A-P 65A quick and easy to install. Adjusting stem is completely accessible for easy manual adjustment — 65 to 300 psi. All moving valve parts operate as one unit. Gives quiet operation, increased bellows life. Low-friction Graphitar block won't wear out. Nylon-reinforced rubber diaphragm gives positive seal — provides flexibility for closing-opening action. Available in sizes  $\frac{3}{8}$ ",  $\frac{1}{2}$ ",  $\frac{3}{4}$ " female N.P.T.

Next time you install a condenser water regulating valve, install the industry's newest, quietest, pressure-actuated valve... the A-P model 65A.



**MODEL 65A  
WATER VALVE**



*Creative controls for industry*

**CONTROLS COMPANY OF AMERICA**

**HEATING AND AIR CONDITIONING DIVISION**

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APRIL  
1961



OFFICIAL PUBLICATION

# JOURNAL

VOL. 3

NO. 4

*Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHAE Journal.*

## FEATURE

Comments by the Editor	39
What About 25 Years from Now in the Heating Industry? H. F. Holtz	41
Sizing Refrigeration System Pipelines for Optimum Economy Donald J. Renwick	42
Ways to Calculate Incident Low Temperature Radiation T. S. Holden	51
Design and Performance of Evaporative Condensers F. L. Levy	55
Pipe and Pump Size Reduction with Medium Temperature Water Homer M. Bird	60
Integrated Time and Temperature As Affects Frozen Food Quality D. G. Guadagni	66

## NEWS

News Highlights	21
President's Page	59
Research Page	70
Chapter News	74
Officers, Committees, Staff	82
Standards Page	88
Amendments to By-laws	79

## DEPARTMENTS

Member



Audit Bureau of Circulations

New Products	12, 28, 107	Candidates for Admission	84
People	72	New Bulletins	98
Coming Meetings	72	Applications	118
Others Are Saying	73	Classified Advertising	124
Advertisers' Index		128	

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The American Hot Dip  
Galvanizers Association  
with the cooperation of  
The American Zinc Institute  
Announces the \$10,000.

*Galvanizers' International*

# Ten Awards of \$1,000. Each



Ten awards are to be made to entrants selected by the judges. Each award will consist of \$1,000 in cash, a suitable medal and a Certificate of Achievement.

*This is not a contest—it is a search for new ideas. ■ Your entry, therefore, will not be judged against others, but solely on its merit and value in developing new applications and markets for Hot Dip Galvanizing. ■ If your idea, in the opinion of the judges, is of practical value to the industry, you will be cited for an award—promptly. ■ Because the Hot Dip Galvanizing Industry is anxious to receive ideas of this type, the judges reserve the right to present more than 10 awards, if the entries warrant.*

**CONDITIONS** ■ Anyone in the world (except members of the American Hot Dip Galvanizers Association and the American Zinc Institute, and their employees and advertising agencies) may submit one or more entries. ■ Entries will be considered by the judges promptly upon their receipt. No entry received after April 30, 1962 will be considered. ■ The Awards will be made for ideas pertaining to: (a) Applications of Hot Dip Galvanizing to a *new or unusual* field, or; (b) An *improvement* in application in fields where Hot Dip Galvanizing is now being used, or; (c) New methods of *after-treatments* of Hot Dip Galvanized products. ■ Each entry submitted must contain: (a) Description and documentation of application. (b) Case history of the application or process accompanied by photo, drawings, formulae, etc. (c) All technical data needed for the utilization of the idea submitted. (d) Release of the application or idea for general use without payment or royalty other than the \$1000 award. ■ The decision of the judges will be final. Award-winning ideas will be retained by the American Hot Dip Galvanizers Association for dissemination throughout industry. Other entries will be returned. ■ No formal entry blank is required but the entry should be accompanied by the name, address and business connection of the individual submitting it. Business firms or corporations may submit entries under their business name, instead of as individuals, if they choose to do so. ■ Entries should be sent to: AMERICAN HOT DIP GALVANIZERS ASSOCIATION, INC., 5225 Manning Place, N.W., Washington 16, D. C. ■ *Note:* For information on galvanizing write to the above address for name and location of the American Hot Dip Galvanizers Association member nearest you.

**THE JUDGES** ■ Dr. Clarence H. Lorig, Technical Director, Battelle Memorial Institute and Past President American Society for Metals. ■ Mr. John R. Daesen, Technical Director, American Hot Dip Galvanizers Association. ■ Mr. John L. Kimberley, Executive Vice President, American Zinc Institute.

## Awards

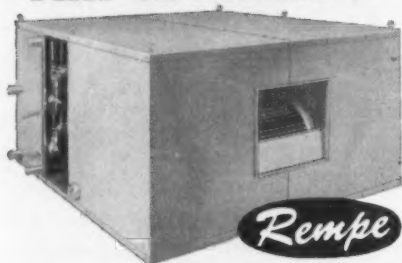
FOR ACHIEVEMENTS  
IN RESEARCH,  
DEVELOPMENT AND  
UTILIZATION OF  
GALVANIZED PRODUCTS



# REMPE

Heat Transfer Equipment

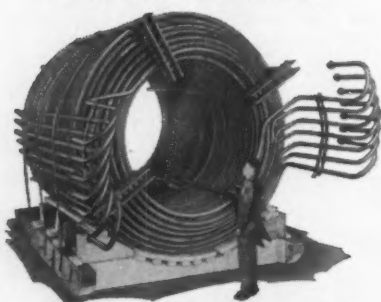
## PACKAGED UNITS FOR AIR HANDLING



**Heating • Cooling • Dehumidifying**  
Unit illustrated is 15-ton capacity with coil for chilling air to 40° F. and a two row steam reheat coil for tempering air to 70° before leaving unit. Air filters and rack included.

Blower handles 4200 CFM air with 1½ HP motor. Two 7½ ton coil sections may be used together or separately. Steel hot galvanized cooling coils are available for Ammonia . . . Copper tube for Freon or chilled water.

## PIPE COILS



**No Problem too Complicated  
for Rempe Engineers . . .**

Complicated assemblies or production runs of Coils or Bends from any type of pipe or tubing can be designed to your requirements. Multiple spiral coil illustrated consists of seven separate circuits of carbon steel tube, electric welded at intermediate joints — Weight 22,000 lbs.

**LARGE OR SMALL  
WE MAKE THEM ALL**



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Data Book**  
Pipe Coil and Fin Coil Designs, Heat Transfer Coefficients. Get a copy for your library.

**REMPE COMPANY**

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## Letters to the Editor

WE TREASURE THIS ONE, TOO

To the Editor:

A few minutes before midnight, I finally got around to removing the wrapper from last month's issue (December 1960) of the ASHRAE JOURNAL.

Immediately, your poignant comment "Alone on a wide, wide sea" compelled me to bob my head out of the dark waters and moved me to assure you that you are not really alone. I and a great silent majority are around and about you.

However, man is frail and the sea is truly wide and deep and cruel. It has a merciless way of slapping down those who make bold splashing waves. Knowing this, the majority of us is smart enough to seldom be heard.

But new hope has dawned. Your simply beautiful editorial, wherein you throw out a lifeline in the form of an "instinctive distrust of all absolutes" is a veritable spear in the side of the authority sharks who circle us for a chance to tear us limb from limb.

We dream; dream of accomplishments in heating, refrigeration, air conditioning, and ventilation and feel that our dreams are sound—that if given a chance they would work and aid mankind. Unfortunately, most of us sink under and die with our dreams unfilled. You give a challenge to the silent ones who wait "for our ship to come in" and who do so often feel alone in the wide, wide sea.

WALTER K. ELY

San Diego, Calif.

### CONCERNED, CONCERNING HUMIDITY

To the Editor:

We are concerned about a number of statements in the article on Humidity Measuring Instruments appearing in the December 1960 issue of the ASHRAE JOURNAL. It is recognized in our laboratories that faithful attention to good operating techniques is required to attain consistently good results from almost any wet-bulb type of device or hygrometer. Based on our experience, it is felt that the article does not fairly represent the capabilities of the various instruments if good techniques are employed. In particular, we have obtained considerably better results, with wet-bulb thermocouples and a properly-designed reservoir, than are illustrated in the article.

The article recognizes that some of the errors may be caused by lack of shielding, heat conduction, poor contact of wick with the thermocouple,

etc., but does not indicate how good the instruments would be if these design features were corrected. The author also suggests that the hair-type hygrometer and the diaphragm-type hygrometer would be more accurate in actual use than under the conditions of the test. This seems to reflect on the choice of test conditions. The article effectively warns the reader that large errors are possible, but, in our opinion, does not reveal the degree of precision that can be attained.

The article does not describe how the various instruments were placed or operated in the test chamber or what air velocities existed therein. The air velocity at the wet- and dry-bulb station ahead of the heating coil is not mentioned. We believe that the test apparatus illustrated could provide either unsaturated, saturated, or super-saturated air at this station because of the by-pass characteristics of all finned cooling coils.

In National Bureau of Standards Research Paper No. 2312, which gives a comparison of the performance of a thermocouple wet-bulb psychrometer and that of a pressure-humidity apparatus, there is a table on page 273 in which the average difference in humidity percentage values obtained by the pressure-humidity apparatus and those values obtained by the psychrometer was  $\pm 0.4\%$ .

In our heat pump testing laboratory, we use the thermocouple psychrometer for determining humidity values in a psychrometric calorimeter. We used No. 30, NBS-calibrated, copper and constantan thermocouple wire. Water was supplied continuously to the thermocouple junction by capillary action from a reservoir. Recently, we made a comparison of humidity values obtained by this instrument and by an NBS-calibrated electrical hygrometer, for a total of 37 non-selected cooling tests performed since February of 1958. The electrical hygrometers were calibrated, in most cases, against the pressure-humidity apparatus described in NBS Paper No. 2312. For tests at return-air RH values from 45 to 55% at indoor temperatures from 75 to 85°F, the following distribution of differences was obtained:

No. of Tests	Differences in relative humidity between calibrated electrical hygrometer values and wet-bulb psychrometric values (%)
22	$\pm 0.0$ to $0.9$
4	$\pm 1.0$ to $1.9$
1	$\pm 2.0$ to $3.0$
1	$> 3.0$

For tests at discharge-air RH values from 75 to 85%, at temperatures around 60°F, the following distribution of differences was obtained:

No. of Tests	Differences in relative humidity between calibrated electrical hygrometer values and wet-bulb psychrometer values (%)
20	$\pm 0.0$ to $0.9$
12	$\pm 1.0$ to $1.9$
2	$\pm 2.0$ to $3.0$

Each test involved at least 7 wet- and dry-bulb readings.

These results, of course, depended upon faithful attention to certain techniques of fabrication of the wet-bulb psychrometer, air-mixing, and thermo-

# FROM THE ROOF... THIS CARRIER UNIT CAN HEAT AND COOL A ONE-STORY BUILDING

without using any floor or wall space!

Designed for installation on the roof of one-story buildings, this low-silhouette Carrier Air-Cooled Weathermaker\* permits complete utilization of floor and wall space. Two capacities fit most heating and cooling requirements—7.5 and 10 tons for cooling; 160,000 and 200,000 Btus for heating. For larger requirements, it can be installed in multiples.

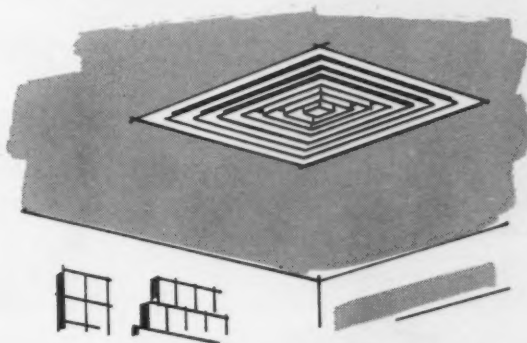
Installation is fast, simple and economical. Expensive ductwork is eliminated, since the unit installs with a single supply and return air duct, thereby requiring only one duct passage to be cut through the roof. Installation is further simplified with only three service connections.

Besides the 48B for heating and cooling, there are two other on-the-roof Weathermakers—the 50AA for cooling only and the 64AA Heat Pump. For information, call your Carrier dealer, listed in the Yellow Pages. Or write Carrier Air Conditioning Company, Syracuse 1, New York.

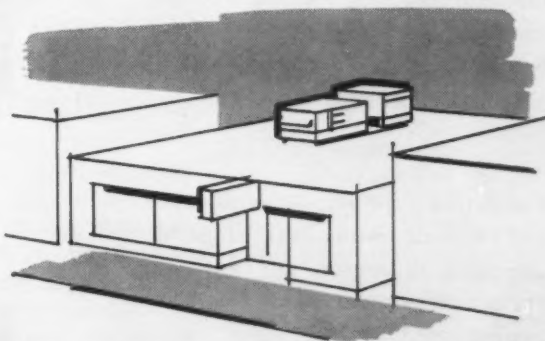
\*Reg. U.S. Pat. Off.



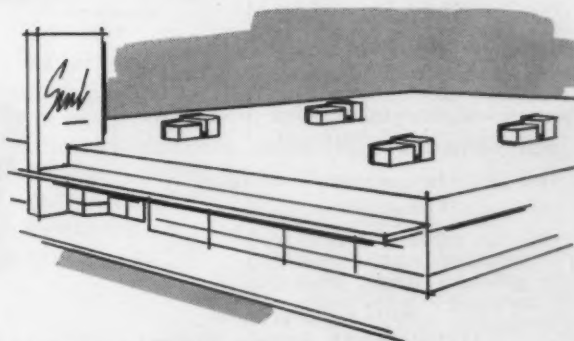
Carrier 48B Air-Cooled On-the-Roof Weathermaker consists of a gas-fired heating section, a fan section and an air-cooled refrigeration section for cooling—all enclosed in a weatherproof casing and mounted on rails. The refrigerant piping is installed and the unit is dehydrated, charged with refrigerant and tested at the factory. Unit is also completely factory wired.



One supply and return air grille fits flush to ceiling—leaves ceiling, floor and walls clear and uncluttered.



A single unit will both heat and cool a small store or plant.



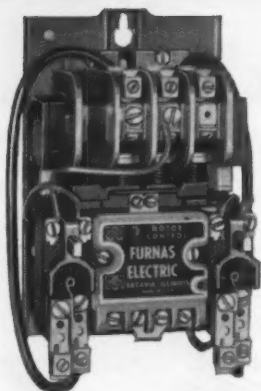
Large buildings require two or more units to heat and cool.

**Carrier** Air Conditioning Company



# new

## CURRENT RATED STARTERS

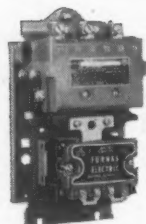


Through 53 amps, rated in full load and locked rotor. Can be used for both 220 volts and 440 volts.

# new

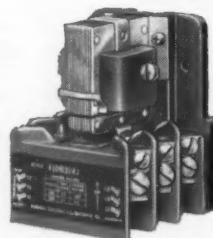
## CURRENT RATED CONTACTORS THROUGH 90 AMPS.

Furnas Electric offers a complete line of current rated contactors through 90 amps meeting requirements of the Air Conditioning and Refrigeration Industry.



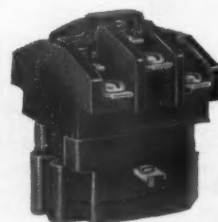
90 amperes

Contactors through 40 amps, 2, 3 and 4 pole with interchangeable mounting dimensions are available for compressor and electrical heating applications.



40 amperes

2 and 3 pole, 25 amp contactors are used for unattended domestic and commercial applications, and for resistance heating applications.



25 amperes

Write for Literature  
1182 McKee St., Batavia, Illinois

A95



## FURNAS ELECTRIC COMPANY

BATAVIA, ILLINOIS

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

couple practices, as well as upon the method of interpretation of observed data.

A comparison was not made for the heating tests since a fine degree of accuracy for humidity of the air stream under heating operation is not as important as under cooling operation where latent change is being measured.

ASHRAE Standard 16-56 requires that both cooling and heating tests be performed by the psychrometric method and by the refrigerant flow method. For tests to be valid, according to the standard, there should be agreement between the results of the two methods to within 6%. Most tests performed during our program since 1958 showed agreement to within 4% and many to within 1%. Such agreement, while it does not entirely confirm the use of the thermocouple psychrometer, does give evidence of its probable accuracy.

J. C. DAVIS,  
General Engineer

National Bureau of Standards  
U. S. Department of Commerce  
Washington, D. C.

THERMODYNAMICS, UNIVERSAL

To the Editor:

The letter of J. C. Davis, General Engineer, National Bureau of Standards, Washington 25, D. C., is somewhat critical of my "A Comparison of the Accuracy of Humidity Measuring Instruments", ASHRAE JOURNAL, December, 1960.

The primary purpose of this article was to inform people of the dangers of picking out standard available humidity measuring devices and using them without proper interpretation of the results obtained. Since an article of this type must be limited in length, it is not possible to describe in detail each and every step that went into the deviation of these data.

I am well aware of the possibilities of obtaining various degrees of saturation in an air stream leaving a cooling coil, and I can assure Mr. Davis that adequate safeguards were set up both in the design of the equipment and in its operation to make certain that saturated air was being delivered during the times that tests were being conducted. Instruments which were susceptible to air velocities were used in such a manner that an air velocity of at least 900 fpm passed the sensing elements.

Concerning the use of a thermocouple wet bulb psychrometer, I stand firmly behind my original position that a great deal of error is possible due to the possibility of mis-locating the wick with relation to the sensing portion of the thermocouple and, in a field operation where no standard is available to inform the operator when a proper location has been achieved, there exists a great deal of room for speculation concerning any wet bulb readings that are recorded. Furthermore, with respect to the instrument shown in Fig. 6 of my article, I again take a firm position in criticizing this type of instrument. I believe that the laws of thermodynamics work exactly the same in the Bureau of Standards' Laboratories as they do in the laboratories of the University of Florida, and if an instrument is used which has a built-in source of heat and a heat conducting path from this source to an element of lower temperature,



then heat transfer must exist from the higher temperature to the lower temperature, which will result in an erroneous wet bulb temperature. This temperature will always be higher than the actual wet bulb temperature.

F. M. FLANIGAN  
Associate Professor

University of Florida  
College of Engineering  
Gainesville, Fla.

#### GREMLINS ARE BACK AGAIN

To the Editor:

We appreciate the prompt publication of our "Reaction of Refrigerant 12 With Petroleum Oils" which appeared on pages 65-69 of the February JOURNAL. The footnote on page 65 states Mr. Doderer and I work for General Hospital Co., which should, of course, read General Electric Co. This error did not appear in the Galley Proofs or Preprints.

H. O. SPAUSCHUS  
Chemistry Laboratory

General Electric Co.  
Louisville, Ky.

To authors Spauschus and Doderer, our sincere regrets. Where and how such errors as this develop must ever remain a mystery.

#### SUPERFICIAL RESEMBLANCE DID IT

To the Editor:

In the publication of our "Predicting Air Friction Pressure Loss in Shallow Ducts," February 1961, the chart which accompanied the caption for Fig. 3 should have appeared as Fig. 5 and vice versa. This makes for some difficulty in understanding the figures at least initially. It will probably be helpful if you will point this out in some succeeding issue of the JOURNAL.

C. P. LENTZ

National Research Council  
of Canada

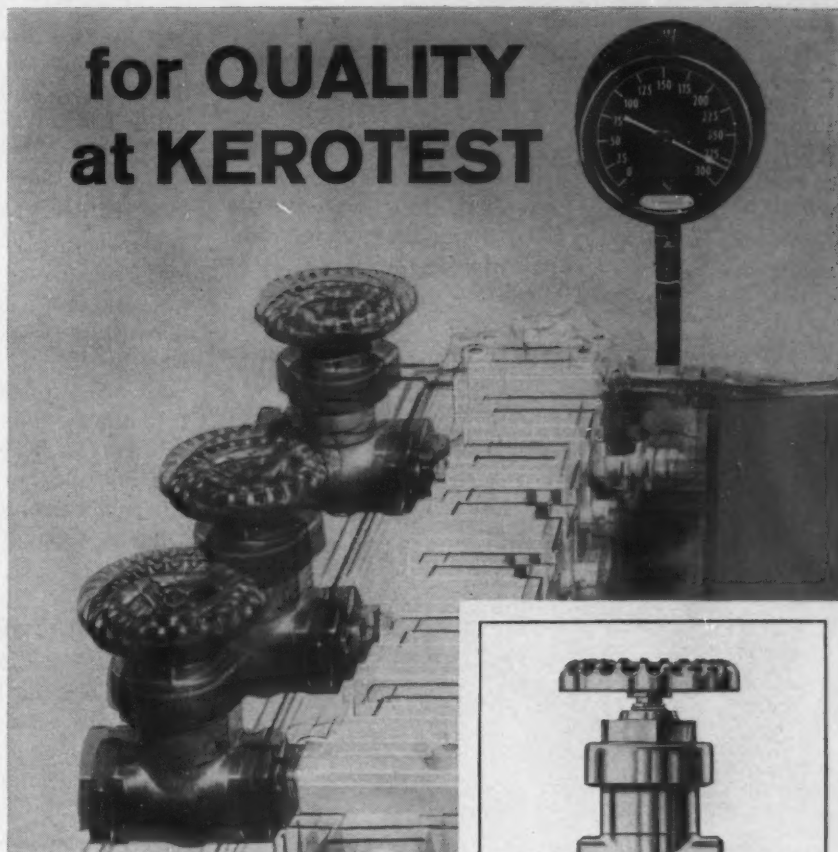
## COMING—JUNE

Previewing the forthcoming ASHRAE 68th Annual Meeting in Denver, Colo. (June 26-28), the June issue of your JOURNAL will present

- Condensed program of meetings and social events
- Abstracts of the 17 Technical Sessions papers to be presented
- Abstracts of Symposium papers
- Outlines of Forums

# SHAKE DOWN

## for QUALITY at KEROTEST



### Vibration-proof Construction

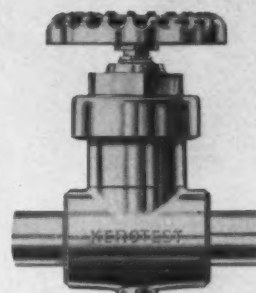
Only precision, quality-controlled construction can take this kind of concentrated abuse. These valves, under a pressurized refrigerant, are vibrated at 3600 cycles per minute for prolonged periods. At intervals throughout the accelerated test, Kerotest engineers evaluate performance and condition of seat seals, diaphragm seals, solder seals and handwheels.

The high standards of material quality and craftsmanship maintained at Kerotest assure you of smoother valve operation and minimum maintenance. Tested and proved design features, quality control at each step of manufacture combine to make Kerotest the best valve that money can buy.

ASK FOR KEROTEST VALVES  
AT YOUR LOCAL WHOLESALERS

KEROTEST MANUFACTURING CO.

2510 Liberty Ave. • Pittsburgh 22, Pa.



KEROTEST 520  
DIAPHRAGM PACKLESS  
GLOBE VALVE

The precision-built brass valve for all types of refrigeration and air conditioning systems. Ideal for liquefied petroleum gas bulk plants, pipe line loading racks, laboratory installations, nitrogen, oxygen (degassed) and compressed air applications.

Specify the Kerotest 520 globe valve for operating pressures up to 400 psi and temperatures up to 200° F. Use it in vacuum service applications to 1 micron.

#### KEROTEST QUALITY CONTROLLED FEATURES

- Replaceable spindle seats for continuous positive seating
- Metal to metal backseating above and below diaphragms
- Beryllium copper and stainless steel diaphragms
- Generous handwheel

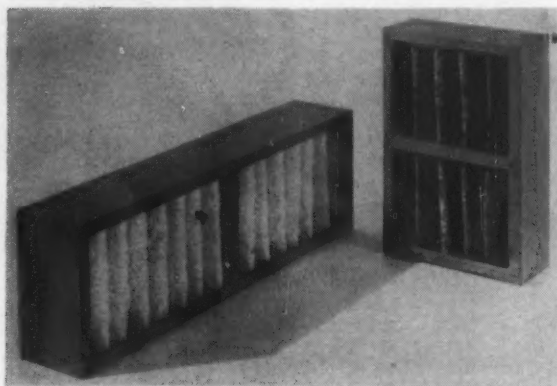
# KEROTEST

# PARTS AND PRODUCTS

## INTERCEPTION FILTER

For room recirculators, kitchen range hoods, electronic cabinet cooling and similar applications, this disposable interception filter, of pleated glass mat material, is cited as providing dust spot average efficiencies from 80 to 95%, depending on the filter media used. Average filter life ranges from 1200 to 10,000 hr, depending on dirt load and nature of supply air.

Comprising the filter is a two-piece, rigid, chip-board frame, supporting Aerosolve filter media. With



the pleated design, it is possible to incorporate four sq ft of filter media into an area 6 in. wide by 20 in. long by 3½ in. deep. Tests of an Aerosolve 95 filter show a resistance from 0.08 in. wg at 60 cfm to 0.52 in. water resistance at 250 cfm.

Cambridge Filter Products Corporation, 738 Erie Blvd. E., Syracuse 1, N. Y.

## MOLECULAR SIEVES

Triple-strength molecular sieves, for use as a refrigerant desiccant, are being produced in the form of 4 x 8 mesh beads. Designated Type 4A XH, they are cited as having a crush strength three times that of the standard Type 4A beads. Although they have a somewhat lower water capacity, this is offset partly by a higher bulk density.

Linde Company, Div of Union Carbide Corporation, 270 Park Ave., New York, N. Y.

## GAS AIR CONDITIONERS

Planned for introduction this year are several gas-fired small tonnage units. Among them are: Models 650 (4.3 ton), 750C (5-ton remote) and 850 (6.4 ton). All are All-Year cooling and heating units. Also to be offered are Model 500C, 3.5-ton remote (for outdoor installation); Model DF-3000, direct-fired absorption water chiller-heater; a vertically installed, 3.5-ton fan-coil-filter assembly, Model FCF 42-96V, to be available in upflow and downflow versions as well as a horizontal model; and multi-directional gas

unit heaters. A 1¼-ton fan-coil-filter unit, FCF 21-48, which will make possible zoning of residential and small commercial applications, also will be available soon. Planned for the future are Models 650C, 4.3-ton remote; 655C, 4.3-ton remote, add-on cooling unit; and D750, a downflow 5-ton. Model D500, a downflow 3.5-ton unit, is now in production.

Arkla Air Conditioning Corporation, 812 Main St., Little Rock, Ark.

## ENCAPSULATED RELAY

To provide the protection necessary for efficient, enduring operation in corrosive, deteriorative atmospheres, the Mini-relay is offered with full epoxy encapsulation. Such encapsulation of the coil additionally affords an integral terminal strip for convenience in installation. Hermetically sealed, mercury-to-mercury, 20-amp contacts offer silent, trouble-free service. Suitable applications include air conditioning, heating and furnaces.

Ebert Electronics Corporation, 212-26 Jamaica Ave., Queens Village 28, N. Y.

## DEHYDRATOR

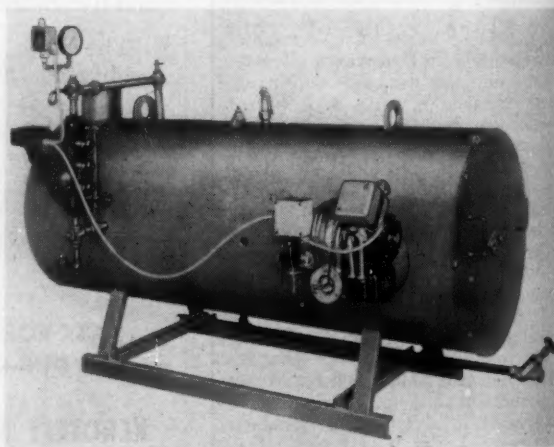
To serve air conditioning systems of from 3 to 100 hp, this chemical reactivating dehydrator will be made in varying sizes. Attached to the pressure line of a central air conditioning system, the unit sends moisture drying chemicals through the system along with the gases. Chemical components include acetylenogens, hellos capacitors and molecular aluminates.

Federated Electronics, Inc., Jamaica, N. Y.

## HORIZONTAL BOILERS

Automatic, self-contained horizontal firetube boilers for oil, gas or combination oil and gas-firing feature side-firing design, cited as reducing end-to-end dimensions. Boilers are rated at 6, 12, 15, 20 and 30 hp at 100 or 125-psi working pressure.

Horizontal firetubes are immersed completely in water to prevent water-line corrosion. Within each



firetube is a "turbulator" that spirals hot gas against the tube walls to remove a maximum amount of heat



1-48,  
and  
lable  
3-ton  
unit;  
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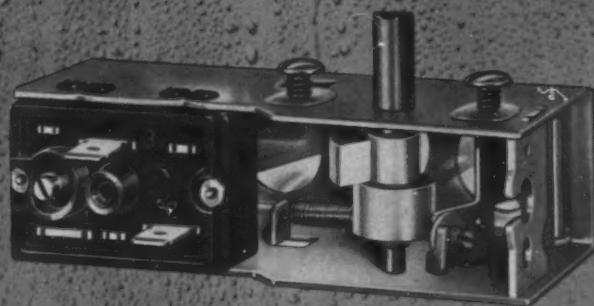
NAL

# Ranco Humidity Controls

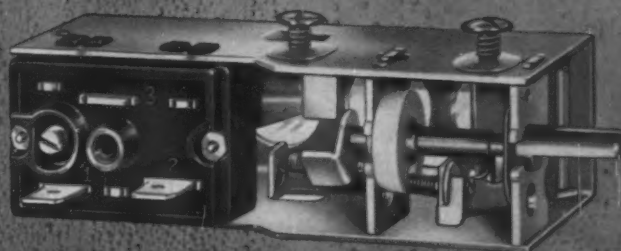
## Two models for control of humidifiers and dehumidifiers

These two new Ranco humidistats, designed for air conditioning systems, respond to the atmosphere moisture content to automatically cycle humidifying or dehumidifying equipment. Both operate within a 20-80% relative humidity range.

The J10 and J11 controls are available in the 1000 series for dehumidifiers and the 2000 series for humidifiers. Both controls are small and compact . . . designed for line voltage or pilot duty usage . . . feature positive "on" and "off" positions, snap-acting switches, and long-lasting power elements. Write for further information and Technical Bulletin 1832.



TYPE J10 with dial shaft at side



TYPE J11 with dial shaft at end



## Ranco®

INCORPORATED, COLUMBUS 1, OHIO

In Canada: Ranco Controls, Canada, Ltd., Toronto 18, Ontario



from the gases before they enter the flue chamber. Boiler shell is of all-welded construction, insulated with glass fiber and covered with a steel jacket. Standard equipment includes burner, appropriate combustion controls and safeguards, low water cutoff and steam pressure controls. Optional are a 10 to 15-ft, 16-gauge metal stack and a condensate return or feedwater pump system for supplying the boiler with water under pressure.

Lookout Boiler & Manufacturing Company, Chattanooga, Tenn.

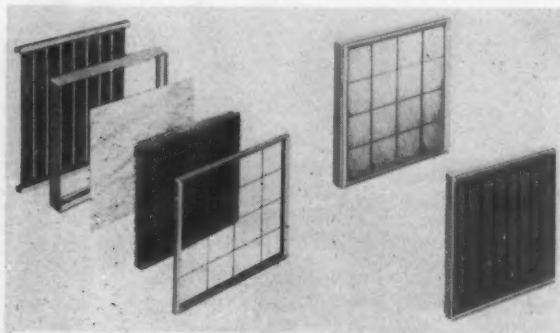
#### CENTRIFUGAL REFRIGERATING MACHINE

Added to this manufacturer's line is a hermetic centrifugal refrigerating machine with cooling capacity of 2000 ton. This unit, combined with recently introduced 1750-ton equipment, expands the line to 51 combinations available with six compressor sizes producing cooling capacities from 90 to 2000 ton. Carrier Corporation, Syracuse 1, N. Y.

#### FILTERS, AIR PURIFIERS

Roto Aire Combination Replaceable Media Air Filters and Activated Charcoal Air Purifiers are contained in a single case, developed for the slide-in type filter section of standard air handling units designed to accommodate a two-in. air filter. Units are flexible, because they may be operated at varying velocities and, in the filter section, with varying densities and combinations of media.

Comprising the adsorber section is a series of replaceable cartridges containing activated charcoal,



for removal of gases and vapors from ventilation and recirculated air.

Burke and Company, 2902 Hyde Park Blvd., Los Angeles 43, Calif.

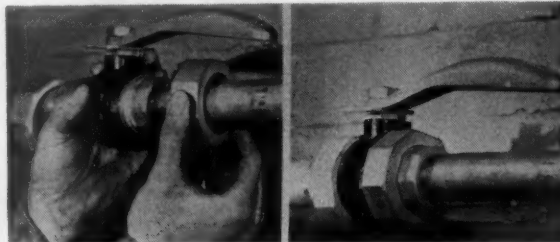
#### BALL VALVE

Featuring improvements in sealing characteristics, compact one-piece forging and built-in union ends which simplify installation, operation and maintenance, this new Petro ball valve is designed to control flow of liquid or gas as in a wide-range of industrial piping systems; rapid installation and fast disassembly for maintenance are featured. But two steps are required for installation: the union ends are either screwed or welded onto the pipe ends and the one-piece valve body then is assembled to the union nut.

Principal advantage cited for the dual seat design

is that the ball, which floats between the seats, makes a tighter seal as it is forced against the downstream seat by increasing pressure. Pressures at the upstream seat are equalized by permitting the fluid to get behind the seat. Thus low frictional resistance is maintained and the valve can be turned easily.

Available in Buna-N, Neoprene and Teflon, the seats are interchangeable to meet most media require-



ments. Maximum pressure rating for all sizes of valves with Buna-N and Neoprene seats is 300 psi; Teflon seats are rated to 600 psi for one through two-in. valves and to 1000 psi for 1/4 through 3/4-in. sizes. Offered in stainless steel, carbon steel or brass, the new ball valve is available in eight sizes, 1/4 through 2 in.

Clayton Mark & Company, 1900 Dempster St., Evanston, Illinois.

#### ROOM AIR CONDITIONER

Introduced by this manufacturer is a new one-hp room air conditioner, 301AC7, which is a 7 1/2-amp, 115-volt model with a cooling capacity of 6600 Btu/hr. It has a thermostatic climate control and a poly-sponge filter that can be rinsed clean. A Flex-O-Mount installation kit with accordion-type sides that permit installation in windows from 27 to 36 in. wide is included.

Admiral Corporation, 3800 Cortland St., Chicago 47, Illinois.

#### AIR HANDLING TROFFER

Units in the Triple-Shell Lumi-Flo line provide light and cool or warm air from a single concealed ceiling fixture. Featured is an air passageway isolated from the troffer housing by glass fiber insulation and an insulating air gap, removing the possibility of temperature variations affecting the light output. Air handling capacity of the units is from zero to 200 cfm from a single 1 by 4 or 2 by 4-ft unit. Installation time is cited as having been reduced substantially by use of a snap-in damper assembly and a side-mount hanger.

Tuttle & Bailey Div, Allied Thermal Corporation, New Britain, Conn., and Benjamin Div, Thomas Industries, Inc., 207 E. Broadway, Louisville, Ky.

#### GLASS DOOR REFRIGERATORS

Three glass door models have been added to this line of reach-in refrigerators. Available for self-contained or remote installation, the new units have net capacities of 21.5, 43 and 67.3 cu ft for remote, and 16.75,

# UNSURPASSED FILTERING AND DRYING with ADDED Convenience and Economy... It's the New Refillable Type *Drymaster*<sup>®</sup> Filter-Drier!

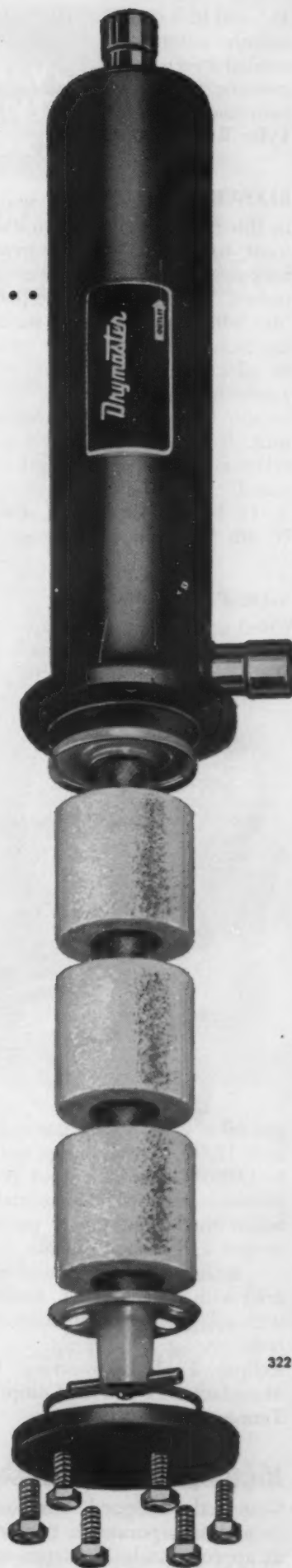
The superb, balanced filtering and drying performance of the new refillable type DRYMASTER comes from HI-FI Filter Block Desiccant: These fully activated, pressure molded briquettes quickly remove all harmful moisture, acid, sludge and micron-size foreign particles from the refrigeration system. HI-FI Filter Block Desiccant is non-dusting, non-channeling and is virtually unequalled in moisture adsorbing capacity. Its combination surface and internal depth filtering ability is unsurpassed by any other comparably sized drier in the field today.

And the new angle-type, refillable DRYMASTER Filter-Drier gives added convenience and economy, too. Once installed, the body shell of the Drier is in for the life of the system; only the desiccant is replaced. DRYMASTER Refillable Filter-Driers are designed for 5 ton through 165 ton capacities with ½" O.D. through 2½" O.D. solder connections. End fittings are made of copper for easier soldering.

HI-FI Desiccant Briquettes, protected against shock by fibre glass padding, come packed in vacuum sealed cans ready to be installed quickly, easily, with no connections or joints to remake.



Write today for Catalog R-159 . . . contains complete information on all Streamline Refrigeration and Air-Conditioning products.



322



**MUELLER BRASS CO.**  
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VAMPCO ALUMINUM PRODUCTS, LTD., STRATHROY, ONTARIO  
Exclusive Canadian Representative for Mueller Brass Co.  
Air Conditioning and Refrigeration Products



38.2 and 62.5 cu ft for self-contained models. Features include exterior mounted, heavy duty hardware; welded-steel construction; conveniently located thermostatic temperature control; efficient drainage system; and perforated base.

Tyler Refrigeration Corporation, Niles, Mich.

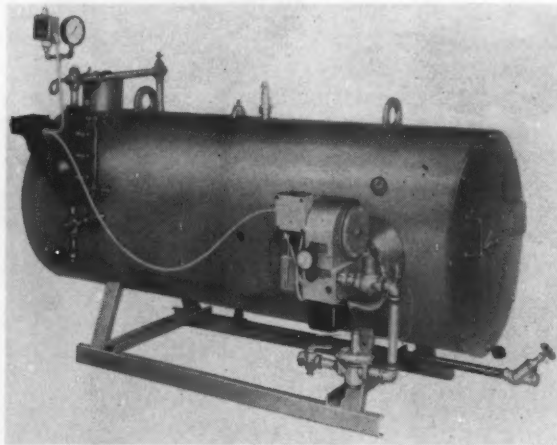
#### BLOWER MOTOR

In this fractional hp design, the outer, stationary element (or stator) of a conventional electric motor becomes the rotor, to which a blower wheel is attached. Field windings are placed in the shaft assembly, which becomes the stator. The outer shell of the motor, rather than the inner assembly, thus spins to effect maximum efficiency of centrifugal blower action in minimum space. Of a permanent split capacitor type, the "Inside-Out" motor is a direct-drive unit, hence the conventional centrifugal switch or relay, and pulleys, belts and motor mounts are eliminated.

A. O. Smith Corporation, Electric Motors Div, 531 N. 4th St., Tipp City, Ohio.

#### SIDE-FIRED BOILERS

Cited as reducing floor space more than 20% as compared with end-fired models of the same capacity, these compact side-fired ST boilers are available in



gas, oil or combination gas and oil-fired models. Rated at 6, 12, 15, 20 and 30 hp, units operate from 201,000 to 1,005,000 Btu/hr output at 100 or 125-psi working pressure standard. Horizontal design puts all tubes below the water line to prevent corrosive action of oxygen and carbon dioxide.

Boiler shell is insulated with glass fiber and covered with a steel jacket. Boilers are factory-equipped with oil, gas or combination gas and oil burner, controls, wiring and piping.

Eclipse Fuel Engineering Company, Boiler Div, Manufacturers Rd. & Compress St., Chattanooga 5, Tennessee.

#### HIGH SPEED COMPRESSOR

Compactly designed, this compressor weighs but 18 lb and incorporates a two-pole motor that operates at approximately 3400 rpm at 60 cycle. Applications

include use in refrigerators, water coolers, freezers, display cases and related refrigeration systems where minimal space is a requirement. Unit is available in sizes of 1/12, 1/10, 1/8 and 1/6 hp.

Rotor, stator and other mechanical parts are mounted on and suspended from protection springs. Constant lubrication of all moving parts is provided by a forced-feed system, with the lower part of the compressor housing serving as the oil reservoir. Motor cooling is accomplished by means of suction gas. Danfoss, Inc., 115 Dell Glen Ave., Lodi, N. J.

#### REFRIGERATION, EVAPORATIVE UNITS

Pre-cooled air from the evaporative air cooler section of the Thunderbird Weatheramic is fed directly into the condensing unit by a powerful, belt-driven blower. This pre-cooled air is 25 to 30 F below the ambient temperature and allows the condenser to operate at a much lower head temperature. Units are manufactured in two and three-ton capacities.

Combination of the evaporative cooler and the refrigerating unit is cited as eliminating the need for installing an over-size machine to take care of peak hot days. The three-ton Thunderbird, using air pre-cooled to 82 F, provides a Btu output of 38,300 and operates at a head pressure of 253 psi in comparison with a head pressure of 320 psi for fan-type equipment. Unit design temperature is for an average of 105 F dry bulb, with a relative humidity of 26%. Gaffers & Sattler, 8111 W. Beverly Blvd., Los Angeles 48, Calif.

#### RELIEF VALVE

Providing a combination of high flow characteristics, cracking pressure accuracy and tight sealing, this 5300 Series Relief Valve operates at pressures from 850 to 7200 psi. Since the valve is referenced externally, it is suited for use as a priority or sequence unit. Operating at temperatures from -40 to 200 F, the valve provides tight sealing to well above 95% of the preset cracking pressure, cited as being made possible by utilizing increasing system pressure on the poppet to raise sealing efficiency.

Virtually no pressure rise occurs with increasing flow, since the design permits system back pressure on the poppet to increase its lift and provide maximum obtainable flow characteristics. An external adjustment permits varying the cracking pressure to meet circuit requirements; interchangeable springs permit change of the entire cracking pressure range.

Circle Seal Products Company, Inc., 2181 E. Foothill Blvd., Pasadena, Calif.

#### COMMERCIAL REFRIGERATION

Range of this expanded line of electric pad-pan heater type units is now from a maximum of 48,000 Btu/hr to a minimum basic rating of 3400 Btu/hr at 10 F TD. Designed for product storage requiring room temperatures from 28 to 36 F, the Hot Pan series may be used within refrigerated storage cases or for single overhead installation. Flocold Hot Pan coolers are fabricated with coils of 5/8-in. OD seam-



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THERMOSTATIC  
EXPANSION VALVES  
and REFRIGERANT  
DISTRIBUTORS

are the **PERFECT PAIR**  
for **PEAK PERFORMANCE**

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designed  
to fit each other  
for  
smoother performance*

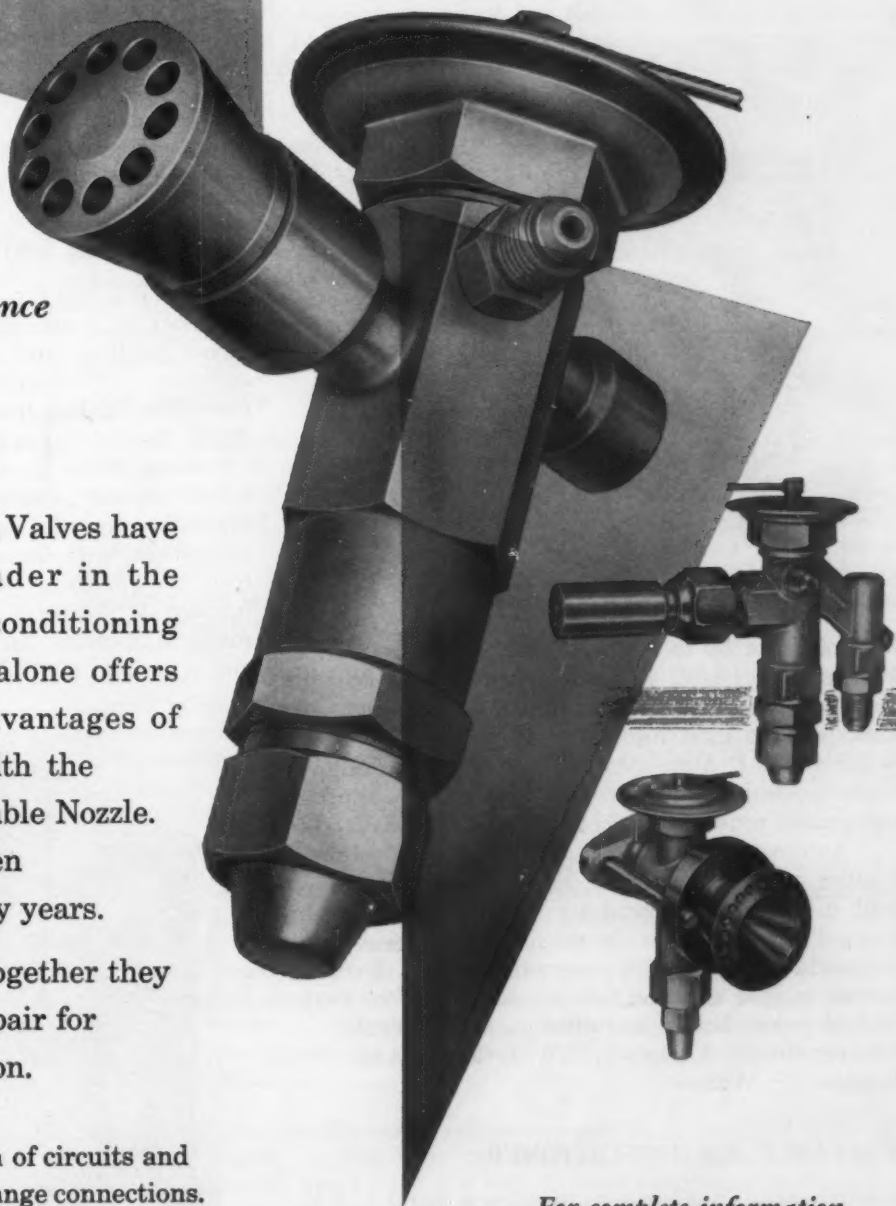
Sporlan

Thermostatic Expansion Valves have proved to be the leader in the refrigeration and air conditioning field... and Sporlan alone offers you the tremendous advantages of the distributor with the Versatile Interchangeable Nozzle.

It too has been  
the leader for many years.

No wonder then, that together they  
make the perfect pair for  
any installation.

Available in any combination of circuits and capacities, in flare, solder or flange connections.



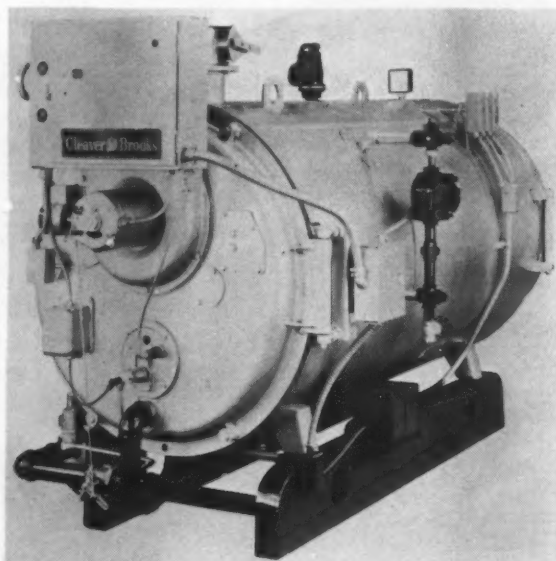
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**SPORLAN VALVE COMPANY**  
7525 SUSSEX AVENUE ST. LOUIS 17, MISSOURI  
EXPORT DEPT. 85 BROAD ST., NEW YORK 4, N. Y.

less copper tubing, mechanically expanded into aluminum fins spaced 48 per ft. Fans are the balanced propeller type. Resilient mounted, lubricated motors have automatic reset thermal overload protection. Drayer-Hanson Div, Hi-Press Air Conditioning of America, Inc., 3301 Medford St., Los Angeles 63, California.

### PACKAGED BOILERS

Combining operation simplicity with fully automatic controls, the CBH fire tube boiler was developed because of the increased use of gas as a primary fuel



for boilers of 50 to 100 hp. This series, from 25 to 100 hp, is available in models that can be fired by gas, No. 2 oil or a combination of gas and light oil. Units can be used for steam, 15 to 250 psi, or hot water systems. Simplicity in operation and design is made possible by elimination of the air atomizing equipment required by boilers burning heavy oil.

Automatic features are centered in a control panel located on the front boiler head. CBH boilers have both a high and a low firing rate and change automatically from one to the other in response to load demands. An electronic programmer shuts down the burner in case of flame failure and purges the boiler of fuel vapors before and after each firing cycle. Cleaver-Brooks Company, 326 E. Keefe Ave., Milwaukee 12, Wisc.

### PORTABLE AIR CONDITIONER

Rolling easily from room to room on a metal cart, the Porta-Cart Air Conditioner can be adjusted to fit windows of various heights. Installation is accomplished by rolling the unit to a window, positioning it with the adjusting handle to the window level and sliding the carriage supporting the air conditioner into the window opening. Aluminum side panels on the Easy-Mount frame slide out and the window is lowered to the top of the frame to assure a weather-tight seal. Units are available in a choice of cooling capacities and can be used in sash windows 30% to

40 in. wide, with still heights varying from 24 to 37 in.

General Electric Company, Room Air Conditioner Dept, Louisville, Ky.

### THREE-IN-ONE SYSTEM

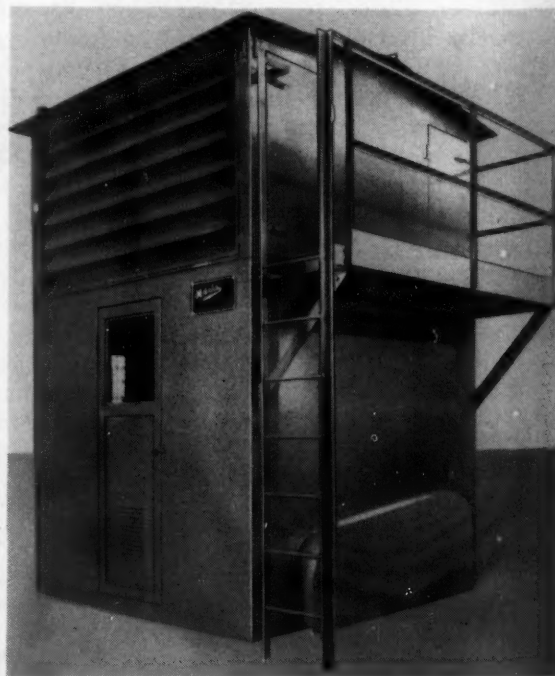
Combination of three basic home comfort requirements—heating, air conditioning and hot water—in one system is offered by this manufacturer. Water heating is accomplished by directing all or part of the 350 F air in the bonnet of the furnace through a special heat exchanger which attaches to the rear of the furnace and has a special coil, containing water to be heated. The resulting hot water is piped to a 30-gal glass-lined storage tank. Any heat not exchanged into the water coil is returned directly to the furnace blower. Recovery of the water tank is cited as being 50 gph on a 100 F rise.

Jet-Heet, Inc., Englewood, N. J.

### MAKE-UP AIR UNITS

Model VR-2 Sun-Flo, in package form to be mounted on roofs of commercial and industrial buildings, is direct gas-fired and automatic in operation. These compact, vertical units are offered in nine sizes with capacities ranging from 20,000 to 60,000 cfm. Capacity in Btu/hr ranges from 1,875,000 to 6,000,000.

Units utilize a minimum of roof space for their rated capacity, with air intake through louvers mounted atop the unit. Filter banks are optional equipment, with filters serviced through access doors from the platform. Automatic controls are mounted inboard, with access through a walk-in door. Automatic shut-down dampers are standard equipment and a remote control station is available with start



and stop buttons and a summer-winter selector switch. Metals Engineering and Manufacturing Company, Inc., 8824 Lyndon, Detroit 38, Mich.



# News highlights of the month

## TRENDS

### Thermoelectricity

With an order for 500 ice cube makers of the thermoelectric type for installation in the Sheraton-Chicago Hotel, the Norge Div of Borg-Warner Corporation becomes an initiator upon the commercial scale of such freezers. Units are modular, of the portable type for recessed installation, and consist of assembled components from various sources. Capacity of each unit is less than  $\frac{1}{2}$  cu ft; 18 cubes, 24 oz of ice. It requires 0.2 amp at 2.4 volt dc at the module and 115-volt ac supply and takes 6 hr to form ice. The sales price is approximately \$250. Announcing the development, Chairman of the Board Judson S. Sayre of the Norge Div stated that this was an opening wedge; that 1 and 2-cu ft units for various small purposes would probably follow; and that thermoelectric refrigeration for the home was probably 3 to 5 years off.

### More gas boilers

According to the Gas Appliance Manufacturers Association, manufacturers' January shipments of gas-fired boilers for residential hot water and steam central heating systems increased 30.9% over the volume reported for the same month a year ago. Shipments of forced warm air and gravity-type gas furnaces for the month amounted to 0.8% less than for January of last year; sales of conversion burners, used in adapting existing heating systems from solid and liquid fuels to gas, showed a 9.9% decline for the month. Combined shipments of the three types of gas central heating equipment totaled 1.2% more than in January 1960.

## BOOK REVIEWS

### NBS research

"Research Highlights of the National Bureau of Standards," Annual Report 1960, presents in compact, digest form an account of NBS research and measurement activities for the fiscal year 1960. Approximately 225 programs in 18 different fields of research and development are described. Additionally, a complete list of NBS publications and patents is included. Copies of 189-page NBS Miscellaneous Publication 237 are available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price is 65 cents.

### For Canadian engineers

Listing career opportunities available for engineers in Canada, "Engineering Careers in Canada", 1960-1961 Edition, facilitates contact between young graduate engineers and those who may require their service; also potentially helpful to Canadian students in selecting a career and later in their choice of employment. Published by the Engineering Institute of Canada, 2050 Mansfield Street, Montreal 2, Que.

### Basic feature

"A well designed air conditioning system tailored to the specific needs of a hospital has become a basic feature of any hospital built to modern standards," writes John L. Brown, administrator of the Community Hospital of Greater Syracuse, N. Y., in a forthcoming textbook for hospital administrators. Mr. Brown, a contributor to *Modern Concepts of Hospital Administration*, to be published next fall by W. B. Saunders Co., states further that air conditioning aids in patient recovery, increases the efficiency of staff personnel, makes good housekeeping easier and less expensive and prevents the spread of odors.

### Less decline

Statistics covering enrollments in engineering schools in the U. S. with one or more curricula accredited by the Engineers Council for Professional Development reveal that for the first time in three years there has been but a slight decline in engineering enrollment. Compiled by the American Society for Engineering Education and the Office of Education in the Department of Health, Education and Welfare, the 1960 findings were published in the February 15 issue of *Journal of Engineering Education*.

### MIT report

Report of the Dean of the School of Engineering, together with accounts from each department on such phases as educational policy, educational activities, graduate programs, research and seminars, are contained in the Report for the Academic Year 1959-1960, School of Engineering, Massachusetts Institute of Technology. Also included are lists of departmental honors and awards and publications.



## SPECIAL MEETINGS

### Air cleaning

There will be an intensive course on air cleaning at the Harvard University School of Public Health, June 19-23. This will consist of lectures and laboratory sessions to provide graduate level training in theoretical and applied aspects. Applications may be made to Harvard School of Public Health, 55 Shattuck St., Boston 15, Mass. Course tuition \$150. Enrollment limited to 40 individuals with special qualifications.

### Temperature Symposium

Sponsored jointly by the American Institute of Physics, the Instrument Society of America and the National Bureau of Standards, the Fourth Symposium on Temperature, Its Measurement and Control in Science and Industry, provided an opportunity for scientists and engineers from various countries to report and discuss their recent contributions in this field. A total of 228 papers was presented covering temperature measurements from absolute zero to 10,000,000 K; also recent advances in high and low temperature measurements were described. Held in Columbus, Ohio, March 27-31; previous symposiums took place in 1919, 1939 and 1954.

### API Conference

Purpose of the Research Conference on Distillate Combustion, sponsored by the Marketing Division of the American Petroleum Institute, was to acquaint manufacturers of oil burning equipment and accessories with API research efforts to help develop new and improved oil burning equipment. Conference was held in Chicago, Ill., March 14 and 15.

### Industrial hygiene

To be held in Detroit, Mich., April 9-13, the American Industrial Hygiene Conference has scheduled a comprehensive program covering virtually all phases of the subject. Among the many speakers are ASHRAE members John H. Clarke and Benjamin Linsky.

### RRF Seminar

Approximately 50 key operating personnel of the refrigerated warehouse industry attended a training seminar, presented by The Refrigeration Research Foundation, designed to assist refrigerated warehouses in improving handling practices. Held in Washington, D. C., February 1-3, speakers included ASHRAE's Professor Carl F. Kayan, who discussed heat transfer problems, and Dr. Walter A. MacLinn, Director of RRF, who described some common warehouse problems.

### Engineering Institutes

University of Wisconsin has made available a list of Engineering Institutes to be held there through June 1961. Indicated are the Institute, date and coordinator. University Extension Division, 3030 Stadium, Madison 6, Wis.

### Managing for profit

16th Annual Management Engineering Conference, sponsored by the Society for Advancement of Management and the American Society of Mechanical Engineers, to be held in New York, N. Y., April 6-7, will concentrate on the topic of improving the technologies of managing for profit.

### Plastics discussed

"Plastics—A New Dimension in Building" will be the subject of a Regional Technical Conference sponsored by the Western New England Section of the Society of Plastics Engineers in Springfield, Mass., April 20. Technical program will feature experts in the use of plastics materials in modern architecture and construction.

## NOTICE TO MEMBERS OF 1961 ANNUAL MEETING

The 68th Annual Meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., will convene at Denver, Colo., at 9:00 a.m., Monday, June 26, 1961.

Continuing through Wednesday, June 28, the meeting will include Technical Sessions covering Heat Transfer and System and Environmental Advances. Symposia are planned covering Domestic Refrigerator Engineering, Food Refrigeration, Industrial Ventilation and Air Conditioning. There will be several Forums on immediate industry problems.

New officers will be installed at the Banquet on Tuesday, June 27.

Every member who can do so should plan to attend this Denver Meeting.

R. H. TULL  
President

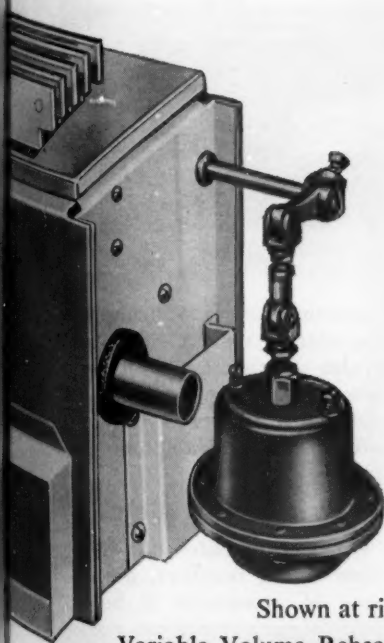
R. C. CROSS  
Executive Secretary

# Variable Volume Reheat

*unit by*

# TITUS<sup>®</sup>

\*developed in conjunction with Minoru Yamasaki... Smith, Hinchman & Grylls, Associated Architects and Engineers



PATENT PENDING

**TESTED AND PROVED** in a 2-story mock-up of the new Michigan Consolidated Gas Company Office Building in Detroit

Shown at right is actual photo of new Titus Variable Volume Reheat units installed in mock-up of Michigan Consolidated Gas Company Office Building. The units were installed under the floor with a 3-inch pre-cast concrete sill containing Titus extruded aluminum Linear Grilles as outlets. *The new Titus VVR units fully met all requirements of the variable volume reheat system.* They proved capable of maintaining room temperature within 1 F—with varying heating and cooling loads.



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Please rush new CATALOG giving complete details on the new Titus Variable Volume Reheat unit.

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# PARTS AND PRODUCTS

## FUEL OIL CONTROLLER

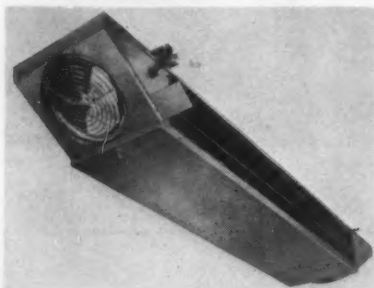
Combining in one casting all the piping, gauges, regulators and valves that have been used in the integral fuel oil control system on this manufacturer's boilers, this new valve assembly is cited as eliminating more than 40 fittings and pipe elbows. The assembly for No. 6 oil integrates these principal control mechanisms into the casting: gauges for fuel oil pressure, return pressure and temperature; ori-



fice gate, back pressure return, bypass, solenoid oil and metering valves; pressure regulator; air purge valve check; and solenoid air purge valve. Cleaver-Brooks Company, 326 E. Keefe Ave., Milwaukee 12, Wisc.

## UNIT COOLERS

By producing a positive, low air movement, Lo-Aire unit coolers provide an even temperature throughout the refrigerated space while still permitting relatively high humidity. This feature



allows longer storage periods, reduces product shrinkage and lowers product temperature more quickly, preventing spoilage.

Seven models are available for temperatures above 34 F, with capacities from 4000 to 26,600 Btu/hr at 10 F TD. Each model is equipped with an automatic electric defrost system, which prevents wide fluctuation in

box temperature and substantially reduces equipment costs by sizing condensing and evaporating equipment on longer running time.

Bohn Aluminum and Brass Corporation, Danville Div, Danville, Ill.

## SEPARATORS, JOINTS

Cast-iron steam and oil separators, sediment separators and brass expansion joints have been added to this company's line of high-pressure steel units.

Available in both horizontal and vertical models, low-pressure cast-iron steam and oil separators are designed for condensate or oil removal where maximum pressures do not exceed 250 psi. Units are produced in sizes ranging from 1½ to 8 in., with a horizontal 125-psi model available in sizes from 1½ to 12 in.

Sediment separators are offered in 125 and 250-psi units in sizes from ½ to 3 in., and feature narrow, in-line construction designed for installation where space is critical in steam, water, air, oil and other service lines. Brass screens with either 0.033 or 0.057-in. diam are standard and optional.

Furnished in eight connecting pipe sizes from ½ to 3 in., brass expansion joints are screwed, semi-guided types with standard traverse ranging from 2 to 2¾ in., depending upon joint sizes. A special series with six-in. traverse is available in sizes from ¾ to 2 in. Designed for installation on steam or hot water heating lines, interior piping, hot water lines, or air, oil or gas service applications, the joints have maximum working pressures of 125 psi for saturated steam and 200 psi for cold water, oil or gas. McAlear Manufacturing Company, 1901 S. Western Ave., Chicago 8, Ill.

## 1961 AIR CONDITIONERS

Models in the Unitaire line are available to meet most design and installation requirements. All air conditioning functions—cooling, heating, dehumidifying, filtering and introduction of outside air—are controlled separately on each unit. Each room can maintain its own desired temperature and has a separate air supply.

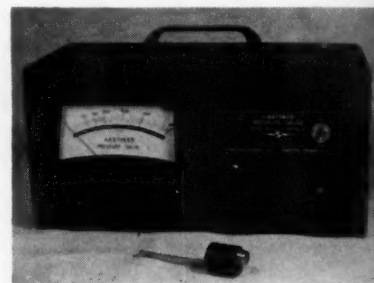
Featured is a face and by-pass damper control that keeps temperature and air circulation constant,

eliminating on and off operation and providing continuous air circulation along with modulated heating, cooling or dehumidifying. A specially designed angle fin coil permits straight-through air flow, cited as eliminating dead air spots in the coil.

Airtherm Manufacturing Company, Box 7039, St. Louis 77, Mo.

## PRESSURE GAUGE

Using an extremely small pressure transducer, this electrical pressure gauge is suited for remote measurement, alarm or control of pressure in the range from zero to 2500 psig. The electrical output can be used for recording, if desired. Operation is on a 115 volt ac, 60-cycle line. Multi-



position pressure gauges utilizing up to five transducers with a single instrument also are available. Transducers are interchangeable without recalibration or adjustment.

Hastings-Raydist, Inc., Hampton, Va.

## AIR ACCESSORIES

For use with floor-mounted and horizontal types of air handlers, an extensive line of accessories is being

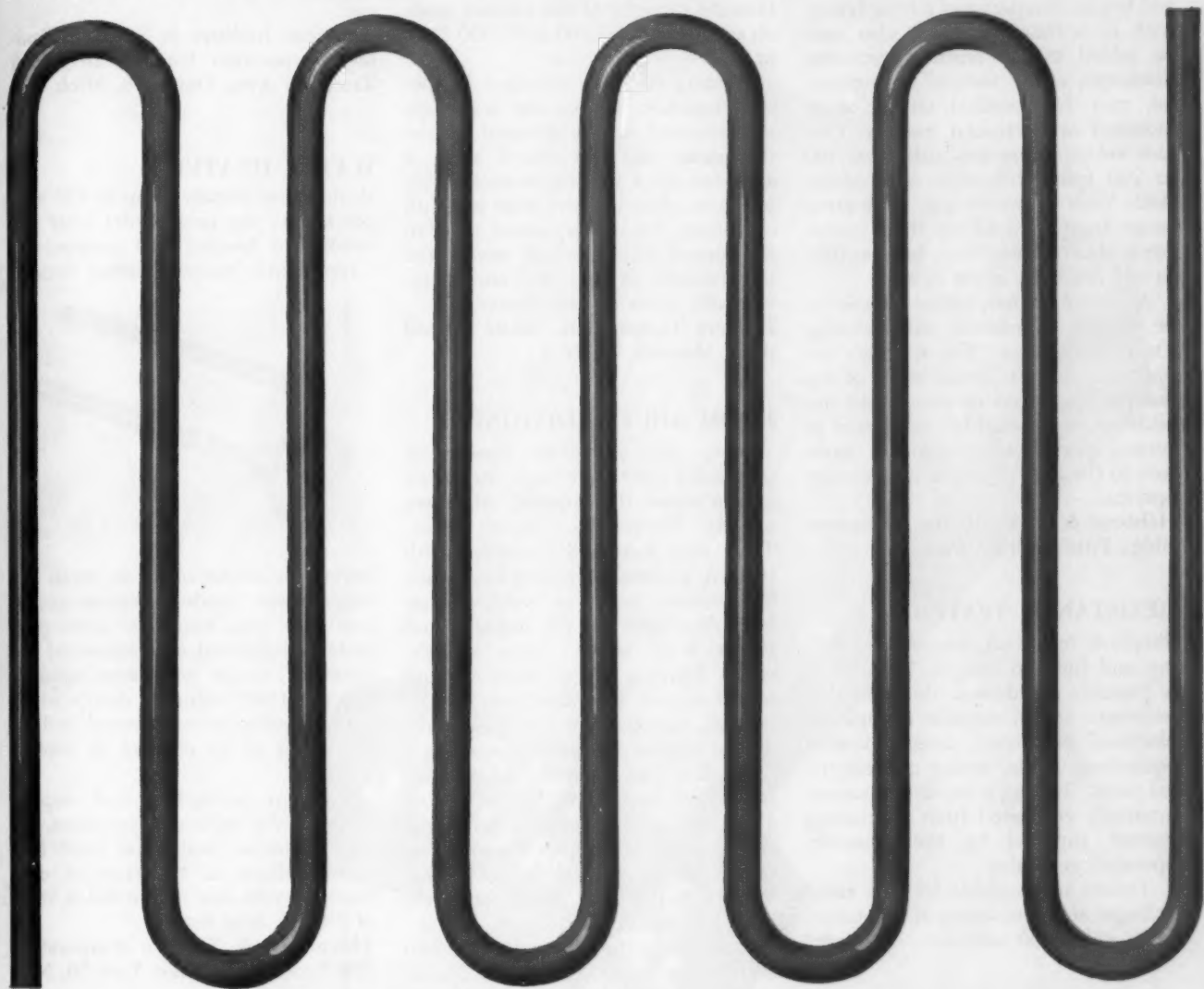


offered. Capacities of the 16-model air handler line, for centralized air conditioning, range from 880 to 47,500 cfm. Units may be used with chilled or hot water, steam or direct expansion coils with a capacity range from 3 to 92 nominal ton under standard conditions.

Filter sections for high or low



## TURN TO ROCHESTER STEEL TUBING . . .



### *your #1 pipeline to FORMING FACILITIES*

Lower cost without lower quality — that's what Rochester Steel Tubing's serpentine forming facilities offer refrigeration people. The secret is in our extensive and unique multiple forming facilities, coupled with tubing know-how. Result: lower cost, meaning real savings to you. Add to this Rochester Steel Tubing's rotary-straightening facilities and you get flat-as-a-pancake ser-

pentines held to close dimensional tolerances. This speeds up wire welding for higher production and more savings. Such facilities and such care help give meaning to Rochester Reliability: to provide you with refrigeration tubing that works the way you want it to work for as long as you specify. More details? Write or wire Rochester Tubing Sales Manager.



*Rochester Reflects Reliability*



**STEEL TUBING BY ROCHESTER PRODUCTS**

**ROCHESTER PRODUCTS DIVISION OF GENERAL MOTORS. ROCHESTER, NEW YORK**

velocity are available with either cleanable or throw-away filters. Face and bypass dampers and mixing boxes, with or without dampers, also may be added to the units. Directional discharge, either vertical or horizontal, may be specified on all floor-mounted or horizontal models. Coil face velocities are available from 400 to 700 fpm, obtainable even under static loads to two-in. wg. Face areas range from 2 to 68 sq ft. Variable pitch sheaves also may be specified to add flexibility of air delivery.

A choice of fins, either aluminum or copper, is offered, all featuring Turbo-Flo design. Fin spacings are optional with six, seven, eight or ten fins per in. Spiral or steam grid humidifiers may be added as desired to control the proper addition of moisture to the air. Vibration isolators are optional.

Halstead & Mitchell, Inc., Bessemer Bldg., Pittsburgh 22, Pa.

### RESISTANCE TESTER

Simple in operation, accurate in reading and light in weight, Type M is a portable handcrank dc insulation resistance tester, suitable for use on electrical machinery, communication equipment, cable, wiring and electrical parts. Testing is by direct current internally converted from alternating current supplied by the manually operated generator.

Testers are available for four rated voltages and five ranges of resistance: 1000 volt/2000 megohm, 500 volt/



1000 megohm, 500 volt/100 megohm, 250 volt/50 megohm and 100 volt/20 megohm. Accuracy is within  $\pm 5\%$  of the rated resistance values. Response of 0.5 sec permits instant reading. Multi-Amp Div, Multi-Amp Electronic Corporation, 465 Lehigh Ave., P. O. Box 217, Union, N. J.

### DUCT FURNACES

Designed for use in conjunction with Flex-Hermetic unified remote central air conditioners, three basic electric

duct furnaces offer two, three and four stages of five-kw electric heat. Heating capacity of the various models ranges from 34,100 to 68,300 Btu/hr.

Heating coils are arranged in special sequence, so that the first stage is connected at the demand of the thermostat and the second stage is activated by a sensing control which indicates when the first stage is in full operation. Also incorporated is a fan air control switch which senses the temperature of the air and automatically shuts off the blower.

Fedders Corporation, 58-01 Grand Ave., Maspeth 78, N. Y.

### ROOM AIR CONDITIONERS

Twenty new room air conditioner models for 1961 have been introduced in four series: the Imperial with three models, Power King with eleven, Titan with four and Casement with two. A window mounting kit, which fits standard sash-type windows, has been developed for the Imperial and Power King series. Titan models, which have a larger capacity and bigger cabinet, have their own mounting kits, and the two Casement units do not require window mounts.

Air flow can be deflected, on Imperial and Power King models, from 15 to 90 deg, directing it towards the ceiling or straight across the room, by means of an "air door." Movable louvers in the door permit complete lateral air direction.

Comprising the Titan series are two 23,000 Btu/hr and two 28,000 Btu/hr models. Standard on all four units are an automatic thermostat, two-speed fan, vent and exhaust controls, four-way direction of cool air and sound absorbent features.

Chrysler Corporation, Airtemp Div, P. O. Box 1037, Dayton 1, Ohio.

### EXPANSION VALVE

Greater capacity in a smaller size is offered by this high performance expansion valve, developed to meet industrial and commercial refrigeration and air conditioning requirements. Designed for use in both original equipment and general replacement installations, the 900 is available in both internally and externally equalized and pressure-limiting types. Capacity in ton is 0.5 to 3 with Refrigerant 12, 0.8 to 5 with Refrigerant 22.

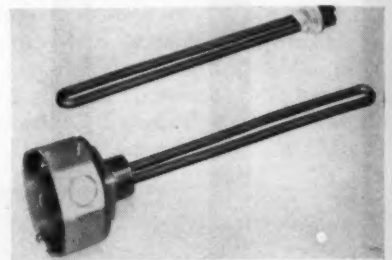
Small removable power element, of stainless steel, is shielded-arc welded. In this design and method of assembly, full diaphragm flexibility is cited as being accomplished. Valve body is a high density brass forging. Ball needle and push rod, with ball con-

centric to rod, are self-aligning and self-centering to assure excellent seating.

American Radiator & Standard Sanitary Corporation, Controls Div, 5900 Trumbull Ave., Detroit 8, Mich.

### WATER HEATER

With a watt-density of up to 150 watt per sq in., the new Model 139P hot water tank heating unit incorporates a replaceable hairpin heating element



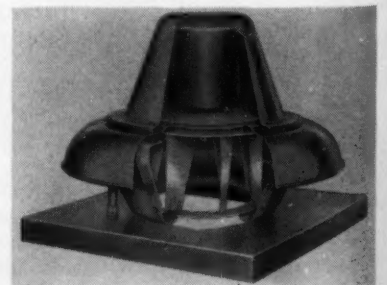
having an output of up to seven kw, single-phase. Made to replace one-in. iron pipe size, one-piece screw-plug units in industrial or commercial hot water or steam generation applications, the 139P features a design which permits screw-driver removal and replacement of its element in case of burnout.

Varistor-protected and copper sheathed for minimum corrosion, the unit is cited as blasting off heavy lime accumulations at the start of each heating cycle due to the shock value of its high heat density.

Thermo-Craft Electric Corporation, 429 E. 164th St., New York 56, N. Y.

### ROOF VENTILATORS

Suited for ventilating public buildings, schools, shopping centers, office buildings and auditoriums, and for exhausting gases and fumes from factories and other industrial buildings, the Model CRD line of centrifugal roof ventilators is offered in eight wheel sizes with capacities from 194 to 2788 cfm at free delivery. Standard



models are equipped with open motors with ball bearings and are mounted in rubber for quiet operation.

**POWERFUL WEDGE**  
INTO A  
**BILLION  
DOLLAR  
MARKET**

**ASHRAE  
JOURNAL**

**AIR-CONDITIONING •  
HEATING •  
REFRIGERATION •  
VENTILATION •**

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**Wm. J. Gatenby, Advertising Manager . . . 62 Worth Street, New York 13, New York • BA 7-6262**

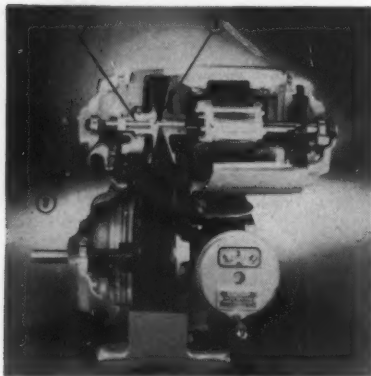


On the backwardly inclined, non-overloading type, fan wheels are fabricated of aluminum. Blades are die-formed and mounted between a heavy-duty backplate and a die-formed rim. A variety of optional accessories is available.

**American Radiator & Standard Sanitary Corporation, Industrial Div., Detroit 32, Mich.**

### LUBRICATION-FREE

Three major lubrication spots have been eliminated on the new variable speed drive here shown. Bearings, sealed and shielded, are factory-lubricated; keys (1) are fabricated from an elastic material to eliminate key



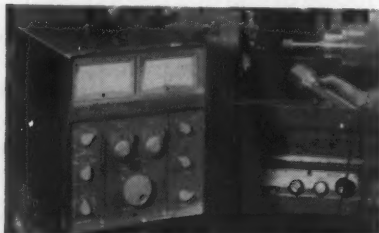
and keyway wear; wear-resistant, non-metallic bushings (2) require no lubrication; and shaft surfaces (3) are corrosion-proof and require no lubrication.

Drives are produced in 1/4 to 25-hp sizes having output speeds of 0.4 to 4660 rpm in speed variations up to 10:1. All drip-proof, totally enclosed, fan-cooled and explosion-proof variable speed models are lubrication-free.

**Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles 22, Calif.**

### VIBRATION ANALYZER

Designed for study and analysis of vibration sources in machinery, buildings and pipe lines, Model 41 Vibration Signal Analyzer and portable balancer incorporates modular con-



struction and transistorized circuitry for reliable operation and low power consumption. The complete unit, in-

cluding stroboscopic light, may be operated on an internal battery pack when portability is required, or on standard 110-volt ac.

Manual-selection of voltage inputs can be varied from 50 microvolt to 100 volt, permitting an amplitude range from 5 microin. to 100 millin., peak to peak, a frequency range from 3 to 10,000 cycle/sec and from 180 to 100,000 cycle/min, and a velocity range from 50 microin./sec to 100 in./sec. Accuracy of these ranges is  $\pm 2\%$ .

Facilities for detailed investigation of discrete frequencies and associated amplitudes within the complete spectrum are provided by a continuously variable frequency filter system (broad  $\pm 10\%$ , sharp  $\pm 5\%$ ). Continuous machine monitoring is obtained by comparing present machine performance with past performance or specific data. Strobe flash frequency is set automatically by the total or filtered signal at the sensing point, visually locating the cause and phase of vibration for analysis or balancing operations.

**RayData Corporation, 1078 E. Granville Rd., Columbus 24, Ohio.**

### CABLE TRACER

To aid in tracing and identifying conductors in cables and conduits, this new tester will trace up to ten conductors or pairs at one time without the need for buzzers, bells or more than one worker. In operation, the ends of the conductors to be traced are plugged into any or all of ten numbered station blocks and the other ends are plugged into the tester itself. Numbers on the tester, corresponding to the numbers of the station blocks, light up to identify the conductors.

**Pyramid Instrument Corporation, 630 Merrick Rd., Lynbrook, N. Y.**



### 1961 CONDITIONERS

Twenty models are being offered in four basic series: the Mighty Mite 7007, Power Master, Wall Slim and Alaskan. With a capacity of 7007 Btu/hr, the first is a 7.5-amp, 115-volt air conditioner designed to fit both casement and double-hung windows. Power Master units are provided with the Expand-O-Mount, an aluminum frame mount which expands to fit most window sizes. Capacities range from 7007 to 10,600 Btu/hr, with several models featuring

reverse cycle heating. Higher cooling capacities of 11,800 to 15,300 Btu/hr are available in the Wall Slim series, which also includes models with reverse cycle heating. To be adapted eventually for use with ductwork as a central air conditioning unit, the Alaskan is a 2 1/2-hp, 20,000 Btu/hr model.

**Welbilt Corporation, Maspeth 78, New York.**

### FLEXIBLE PIPE

For use on piping installations having a temperature operating range to 250

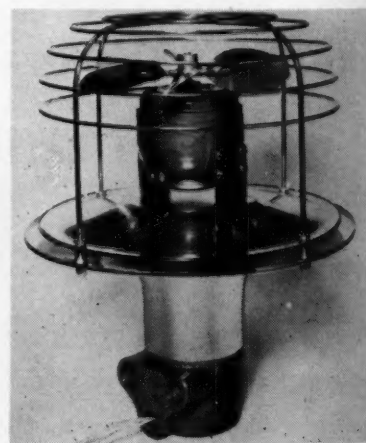


F, Soundzorber HT pipe utilizes Neoprene throughout and uses heat-resistant Dacron in the body in place of conventional cotton duck. This temperature-resistant construction is cited as withstanding easily the temperature change from winter to summer climatic conditioning in a dual heating-cooling system. All pipe sizes up to 12-in. diam are available, furnished with standard integral full-faced flanged ends. Standard lengths are available to nine ft.

**General Rubber Corporation, 67 Summit St., Tenafly, N. J.**

### HUMIDIFIER

Steam vapor is discharged by the Steamette humidifier in a 350 deg radial pattern; portions of this discharge may be blanked off as required. Maintenance is kept to a minimum by corrosion-resistant con-

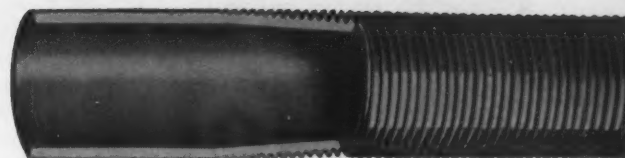


struction. Desired humidity levels are controlled automatically.

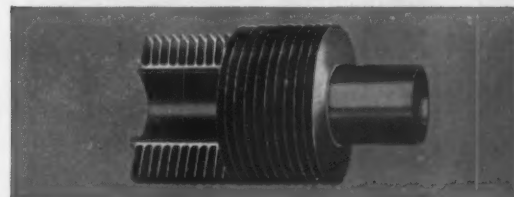
# TRANSFERRING HEAT?

**Only Wolverine Tube has a  
complete line of finned tube!**

If your heat transfer application calls for additional service and extended surface tube—then Wolverine Tube can help you do a better job. From Wolverine's more than 30 years of experience has come the industry's most complete line of finned tube. You can, for example, specify integrally finned tube in low-fin form for shell and tube applications, in high-fin form for air-cooling or heating operations, with external-internal fins for maximum heat-transfer surface on both sides or in low-fin or high-fin duplex form for maximum corrosion resistance. And, for applications such as direct expansion water chillers, there's Wolverine aluminum insert water chiller tube—a copper tube with an aluminum insert. We'll be happy to tell you about any or all of them. Just wire, write or call—or ask your Wolverine Tube salesman —HE KNOWS!



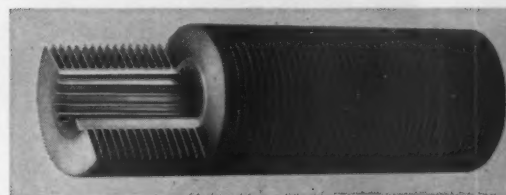
WOLVERINE TRUFIN® TYPE S/T



WOLVERINE TRUFIN® TYPE L/C (Bimetal)



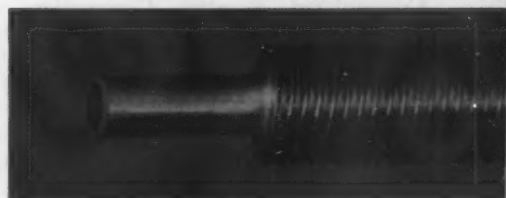
WOLVERINE TRUFIN® TYPE W/H



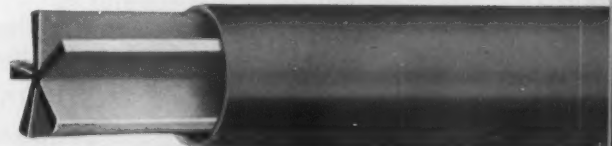
WOLVERINE TRUFIN® TYPE I/L



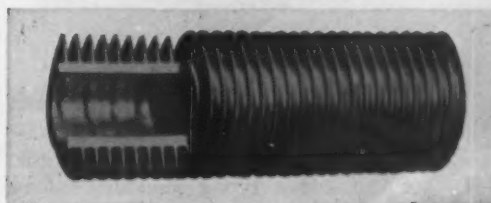
WOLVERINE TRUFIN® DUPLEX S/T



WOLVERINE TRUFIN® TYPE H/R



WOLVERINE ALUMINUM INSERT WATER CHILLER TUBE



WOLVERINE TRUFIN® TYPE H/A

**WOLVERINE TUBE**  
DIVISION OF  
**Calumet & Hecla, Inc.**  
DEPT. L., 17244 SOUTHFIELD RD., ALLEN PARK, MICH.  
TUBEMANSHIP in Copper—Copper Alloys—Aluminum—Special Metals

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA.  
SALES OFFICES IN PRINCIPAL CITIES



Installation of the lightweight unit is made by connection to existing steam supply lines and electrical outlets. Use of an atmospheric drain line rather than a condensate return line to the boiler eliminates the need for steam traps. Design of the unit permits re-evaporation of steam condensate during the operating cycle, but the drain line is required to remove excess line condensate on start-up. Operation is on steam pressures from 2 to 30 psig and on 115-volt current. **Bahnsen Company, 1074 Marshall St., Winston-Salem, N. C.**

### ISOLATION PAD

Using specially processed, high density glass fiber material, vibration isolation pads eliminate lagging machinery to

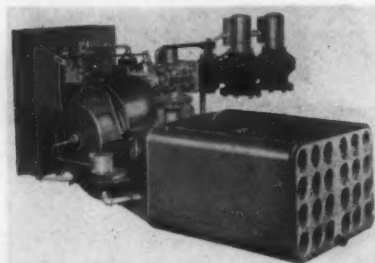


the floor, without cementing, sawing or floor drilling. Pads are furnished in 18 x 18 x 1/2-in. sheets which are pre-scored (as can be seen in the illustration) at two-in. intervals for fast cutting to size on the job site with a knife.

Guaranteed not to creep, the product permits mobile rather than permanently installed production machinery for efficient work-flow. **Consolidated Kinetics Corporation, 1065 Dublin Rd., Columbus 12, Ohio.**

### GAS BURNERS

"Building block" principle of component design has been applied to a new line of automatic motorized, mechanical-draft gas burners. Custom Fan-Air burners feature a selection



of six burner sizes in fifteen burner assembly variations, providing capacities to 35,000,000 Btu/hr. Units are of the inshot type. Standard inter-

changeable parts include: four different valve manifold assemblies, seven control cabinet arrangements and three optional oil assemblies for stand-by fuel firing.

**Mettler Company, Inc., Div of Eclipse Fuel Engineering Company, Rockford, Ill.**

### SHUT-OFF VALVE

Rated to 6000 psi operating pressure in liquid or gaseous service, 920-T Series Shut-off Valve is constructed entirely of 303 stainless steel with Teflon seals and is intended for use where corrosive conditions are severe. To meet these applications, internal design of the units features standard Teflon V packers for a dead tight seal instead of conventional O-rings. Incorporated also is a floating sleeve, which rises to protect the V packers from fluid flow when the valve is open.

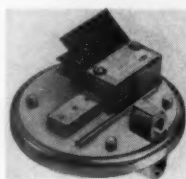
**Circle Seal Products Company, Inc., 2181 E. Foothill Blvd., Pasadena, California.**

### PRESSURE SWITCH

Compact (four in. diam) and of excellent sensitivity, Series 1800 operates from differential pressures as low as 0.15 in. water, with ranges to 80 in. water. The switch will hold a set point through various total pressures and can be operated from plus, minus or differential pressures in any position.

Various arrangements are available, from a basic unit, incorporating operating arm protection, to switches with weather boot of Neoprene, regular conduit enclosure or explosion-proof housing. Pilot lights, showing energized circuits, and other features can be incorporated easily to meet specific needs.

**F. W. Dwyer Manufacturing Company, P. O. Box 373, Michigan City, Indiana.**



### STRAINERS

Revised and expanded, this line of Y strainers is heavier in design than previous models. Nos. 530 and 530-G are suitable for steam, water, air, oil or gas applications and are designed to protect traps, regulators, meters and other equipment from dirt, scale, pipe cuttings and other foreign matter.

Sizes and materials available are: 1/4 to 3 in. in semi-steel, 3/8 to 2 in. in

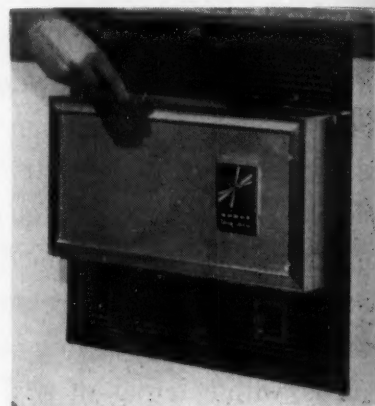
ductile iron or cast steel, 1 1/2 to 2 in. in bronze or stainless steel. Stainless screens are standard for all strainers, with choice of four perforation sizes.

No. 532 block steel angle strainer is designed for service to 1500 psig at 850 F, cold pressures to 3500 psi-wog in carbon steel, and higher pressure-temperature applications with the chrome molybdenum steel series. Offered in connecting pipe sizes 1/2 to 3 in., strainers are suited for continuous (surface) blowdown assemblies.

**McAlear Manufacturing Company, 1901 S. Western Ave., Chicago 8, Ill.**

### THERMOELECTRIC FREEZER

Unlike conventional refrigerator-freezers, these thermoelectric units have no mechanical parts, compressor or refrigerant. Cooling is obtained



by application of dissimilar metals, which produce a sensible temperature change at the junction of the two metals when a direct current is passed through them. The amount of cooling taking place is proportional to the amount of current flowing. In this case, the dissimilar metals are alloys composed of bismuth and tellurium, plus smaller amounts of an impurity element, having in one case an excess of electrons and in the other a scarcity of electrons, to form a negative and a positive element, respectively. These elements are joined in series by copper conductors; in the units offered, eight positive and eight negative elements are assembled to form a module. Three modules are contained in each freezer.

**Norge Div, Borg-Warner Corporation, Merchandise Mart Plaza, Chicago 54, Ill.**

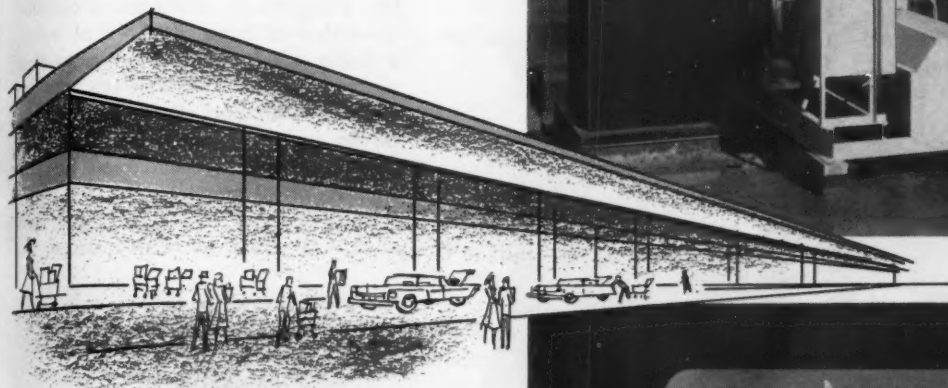
### HOT WATER HEATER

Key feature of this new unit is that it contains its own water pump and can operate from the same tank that supplies hot water for baths, laundry and dishes. Designed chiefly to pro-

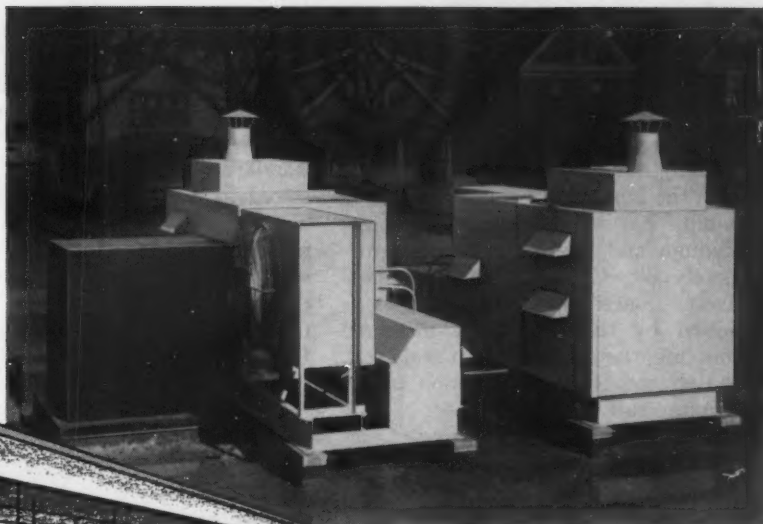


# NOW...

## Complete Control of Comfort from



## WITHIN THE CONDITIONED AREA with



## ROOF MOUNTED AIR CONDITIONERS by DUNHAM-BUSH

Dunham-Bush 'RMC' roof mounted conditioners, developed to meet the ever increasing need to save floor space in conditioned areas, are now available with a central control station which permits "direct dialing" comfort control from within the conditioned area.

Panel control provides for easy heating or cooling adjustment and automatic push button reset... prevents tampering... saves time... reduces maintenance. Pilot lights provide complete visual indication of system's operation: indicator light advises when filter needs replacing.

Central control station can be used to govern operation of several units serving a single zone, or to control a single unit serving several zones.

'RMC' units are available in 5, 7½, 10 and 12½ ton models and are easily installed atop any single story building. Heating or cooling is immediate at the flick of a switch. Air cooled, 'RMC' units require no plumbing or piping connections, are furnished completely factory wired, with all interior plumbing assembled. Units can be furnished for use with remote diffuser applications.

It will pay you to investigate this modern, economical air conditioning-heating system. Form No. 6023A, free on request, contains complete details.

### DUNHAM-BUSH

### DUNHAM-BUSH, INC.

WEST HARTFORD 10, CONNECTICUT, U. S. A.

SALES OFFICES LOCATED IN PRINCIPAL CITIES

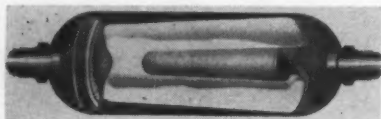
vide supplemental heat, output of the unit ranges from 5000 Btu/hr at an entering water temperature of 120 F to 16,500 Btu/hr at 220 F.

A single motor (three-speed, tap winding, shaded pole type) drives both the fan and the water circulating pump. Power requirements on high, medium and low speed are approximately 90, 45 and 35 watt, respectively. Since the pump impeller is driven by the motor via magnetic coupling, there are no water seals and, consequently, no high friction power requirement.

**Iron Fireman Manufacturing Company, 3170 W. 106th St., Cleveland 11, Ohio.**

## DRIER

By elimination of plastics, fiber board, cotton and other foreign materials from the inside of the drier, and by using a solid core of molecular sieves without diluents, the Filter-Kore Drier

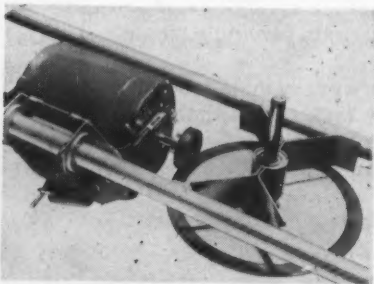


is cited as providing maximum protection to a system from acid and sludge after motor burnout. Sizes available range from one to fifteen ton.

**Kenmore Machine Products, Inc., Lyons, N. Y.**

## ATTIC, EXHAUST FANS

Featured on the Roto-Drive line of attic and exhaust fans is a newly developed drive cited as eliminating the drive belt and pulleys and locating the motor directly in the cooling air stream. Driving system of the units consists of an all-angle electric motor with automatic thermal overload which, by means of a drive



wheel, powers a steel hub. Since the motor is located in the air stream, it is cooler while running.

Expanded polystyrene mounting strips are furnished to insure quiet, rumble and vibration-free operation. These strips also serve to seal the

attic or wall opening to prevent undesirable recirculation.

Because of the structural design of the new drive system, the overall size of these units is less than that of standard-type fans, enabling it to be stored in less space. Comprising the line are five attic and eight exhaust models, ranging from 24 to 48 in. in size. Shown is a close-up detail of the driving mechanism.

**Consolidated General Products, Inc., Houston, Texas.**

## WATER HEATERS

Highlighting the 1961 water heater line are reduction in the number of models and elimination of cement-lined heaters. Reduced from 28 to 19 units, the line offers two types of heaters, silver and glass-lined.

In the silver-lined series, 30-gal models are available in both round and table tops, 40-gal in round and table tops with quick recovery wattages offered, 50 and 52-gal sizes in round and table top models with either standard or quick recovery wattages, and 82-gal models in round only. Featured are an automatic thermostat adjustable from 120 to 180 F, extra heavy gauge galvanized tank, hot water trap and cold water baffle.

Offered in the glass-lined series are 40-gal models in both round and table top, standard or quick recovery; 52-gal in round only, standard or quick recovery; and 82-gal in round only.

Incorporated in the silver lined tanks is a wrap-around unit; glass-lined models will be equipped with Calrod immersion units.

**Hotpoint Div, General Electric Company, 5600 W. Taylor St., Chicago 44, Ill.**

## AIR PURIFIER

Compact and portable, Sano-Fresh No. 17 will plug into any outlet and can be moved to any room in the house. Contaminated air is forced through activated carbon, removing odors, smoke and other air impurities, and is recirculated. Construction is of spun anodized aluminum.

**Roark Industries, Inc., P. O. Box 29, Oklahoma City 1, Okla.**

## RECORDING THERMOMETER

Recording temperature for seven days, without attention, on a 3 3/8-in. diam circular chart, this portable recording thermometer features a dry stylus, moisture-proof chart paper and an eight-day, spring-driven chart mechanism. Temperature ranges offered are from -20 to -220, -40 to -140,

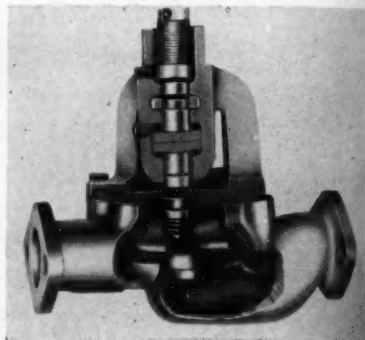
-30 to -70 and -40 to -160 F. Interchangeable snap-on actuating elements are available to change the range of the basic instrument.

**Airserco Manufacturing Company, 435 Melwood St., Pittsburgh 13, Pa.**

## WATER CIRCULATOR

Featured on this Even-Flow circulator, designed for multi-zoned circuits, are a shut-off head of 14.5 ft of water, a flatter characteristic curve so that more multiple zone circuits can be satisfied with one circulator and low power consumption (1/2-hp motor). At 10-gpm flow-rate, developed head is 13.2 ft; at 30 gpm, it is 10.0 ft.

Impeller and shaft are of stainless steel. Webbed casting isolates the



bearing from the pump body, lowering operating temperatures. Also featured is a spring coupling designed to minimize vibration, noise and shaft wear. Circulator dimensions and flanges, 1 or 1 1/4 in., are standard.

**Edwards Engineering Corporation, 101 Alexander Ave., Pompton Plains, New Jersey.**

## AIR HANDLER

Suited to a wide variety of applications in many types of buildings, the Twinalator is a single-impeller, package-type unit which provides both supply and exhaust simultaneously. Advantages cited are: but one opening is necessary; a single motor, drive and starter are involved, reducing both maintenance and first cost; fresh air supply is drawn from above roof level.

Air supply delivered under pressure to the unit can be directed by adjustable louvers at the unit or ducted to specific areas. Exhausted air can be discharged from under the roof or ceiling for general ventilation or carried away from the source to prevent contamination of the over-all area. The unit is applicable for temperatures to 200 F.

Features include: weather-resistant construction, shaft and prelubricated sealed ball bearings shrouded from air stream, motor and adjustable drive

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RNAL



There are 20 different brands of in-line refrigeration driers on the market today. ANSUL is introducing No. 21. We're entering this crowded and highly competitive field for just one reason: the new ANSUL "System Boss" drier will do a better drying job at a lower cost than any of the others.

The "System Boss" makes it possible for you to use a smaller-sized—and consequently less expensive—drier than many of those you've used in the past. It's possible because improved flow characteristics reduce pressure drop . . . because of a better filter arrangement . . . because of a superior desiccant. The "System Boss" is available in all popular sizes from better refrigeration wholesalers everywhere.

**ANSUL**

ANSUL CHEMICAL COMPANY  
MARINETTE, WISCONSIN

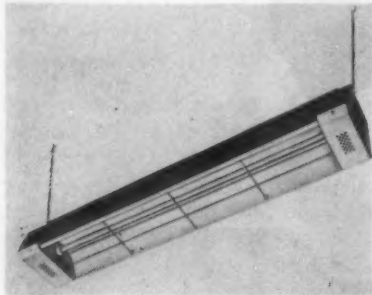


pulley located externally, working parts readily accessible from the roof, bird screens on both inner and outer channels, inner and outer weather caps of natural finish aluminum, and inner and outer cylinders, motor enclosure and curb plate of galvanized steel aluminum-painted.

**Clarage Fan Company, One Clarage Pl., Kalamazoo, Mich.**

### INFRA-RED HEATER

Spot area heating indoors or outdoors can be accomplished with suspended Quartz-Ray infra-red units. Heat is generated, at low amperage, by a

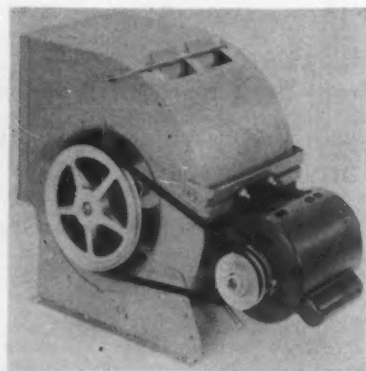


tube. Units are available in 1000, 1500, 2000, 3000 and 4000-watt sizes. 1000 and 1500-watt heaters are offered in 120 and 240 volt, the others in 208 or 240 volt.

**Seaboard Products Corporation, 191-3 Frelinghuysen Ave., Newark 8, N. J.**

### VOLUME REGULATING

An integral part of a blower assembly housing, the Controllaire is opened or closed to adjust volume. Unlike conventional dampers, it is so designed as to permit air redirected by



the damper to flow out of the blower housing through rectangular openings. This air is recirculated within the blower compartment. By means of this method, the blower motor remains at a constant speed, no matter at what setting the damper is placed. Manually controlled, the damper can be installed with various types of knob or other controls mounted on

the exterior unit housing. Initially, the Controllaire is being incorporated into nine and ten-in. diam direct drive blower assemblies and nine, ten and twelve-in. diam belt drive blowers.

**Lau Blower Company, 2027 Home Ave., Dayton 7, Ohio.**

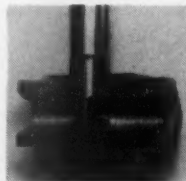
### INSULATING FOAMS

Two developments in insulating plastics foams have been made by this manufacturer: rigid urethane foam boards with high solvent resistance and low thermal conductivity (K factor is 0.16 to 0.17 at 70 F), and a blue Styrofoam insulation board with flame-retardant properties. Designated Thurane, the former is intended for application in refrigeration appliances, pipe and refrigerator truck insulation, and roof, sandwich panel and low temperature space insulation.

**Dow Chemical Company, Midland, Michigan.**

### SHUT-OFF VALVE

Having no organic parts, this solenoid-operated shut-off valve may be used over a broad range of temperatures and pressures and with a wide variety of fluids. Line connection, chamber, seats and plunger sleeve are integrated within the unitized body of aluminum and stainless steel, which results in fewer assembled parts and ends maintenance problems caused by organic seals such as O-rings, washers, gaskets and packings.



Port sizes from 1/16 to 1/2 in. are practical with the new valve. Straight-through flow permits small line sizes, because turbulence and pressure are minimized. Only movable parts of the valve are the plunger and sealing disc, both operating with quite low friction. Several models are capable of withstanding pressures to 5000 psi. Applications are in hydraulic systems, industrial air conditioning and household appliances.

**Polymet Company, P. O. Box 321, Orange, N. J.**

### AIR CONDITIONERS

Ten of the fifteen models in this new line use the one-hp Space-Saver chassis, which measures 15 3/4 in. deep, 15 3/4 in. high and 26 in. wide. Balance of the line features 2 and 2.5-hp models.

Perma-Quick installation consists of a metal pull-out frame and side panels that are scored and can be broken off evenly at the desired width. Housing is positioned on the

window sill, adjusted for width, side panels are added and the assembly locks itself in place. Gasket is added, the window pulled down and the chassis slid in to complete the installation.

Available for all but the 2 1/2-hp model is the Ionitron air charger, offered for allergy relief. Units range from capacities of 6600 to 12,000 Btu/hr.

**Philco Corporation, Tioga & C Sts., Philadelphia 34, Pa.**

### GAS LINE FILTER

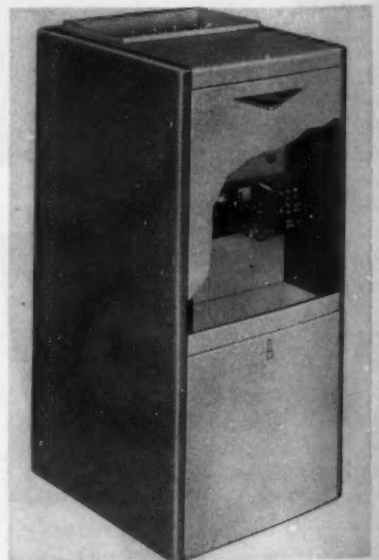
Designed to prevent clogging of furnace and appliance pilots by eliminating dirt, pipe scale or other foreign matter from natural gas lines, this filter is available in two standard sizes, 3/4 and 1 in., with female threaded inlet and outlet. Maximum safe operating pressure is 125 psi. At rated capacity, initial pressure drop through the filter is approximately one in. of water.

**Air-Maze Div, Rockwell-Standard Corporation, 25000 Miles Rd., Cleveland 28, Ohio.**

### ELECTRIC FURNACES

Added to the Thermo-Pride line of residential heating and cooling equipment, electric furnaces are offered both in utility room models and suspended units. All are self-contained and quite compact.

Shown here, the utility furnace is available in a capacity range of 34,000 to 68,000 Btu/hr. Featured are a low-voltage thermostat, quiet step-control panel and an oversized blower. Fil-



tered air can be returned from either side or the bottom.

**Thermo-Products, Inc., North Judson, Indiana.**



## Comment

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## NOTHING CERTAIN, BUT UNCERTAINTY

Among the many motivating impulses to which we humans are subject there are few stronger than the impact of the unknown. It is the power behind all religions, it is the inspiration of all scientists, it is sometimes the despair of engineers, it is the field of editors and it is the fear of a large proportion of the race.

Thus, to the unknown there is owed a twin debt of inspiration and desperation.

Seldom do we stand, as only recently, before a shining new consumer product, a plausible succession of triumphs by science, research, engineering, merchandising and management, but that we are impressed with the probable things which still remain unknown. The imponderables whose existence ultimately spells the future success or failure of the aggregate design-engineering accomplishment.

There is no mystery about this. In spite of million-dollar proving grounds and purposeful programs the automobile industry, for example, can produce occasional "lemons" which have come close to wrecking some long-established industry names; because of undiscovered "bugs". Assuredly, there are other examples, some that come far closer to home, but that cited will do.

Thus, when we hear an enthusiastic product development man say of a new device, just placed upon the production line, that it is good for 20 or 25 years of service-free operation, we choose to be a bit skeptical in our own way. Maybe it is; maybe it isn't. But, assuredly, accelerated age tests, pilot distribution in a selected field or the best efforts of those who would anticipate difficulties have long proven far from wholly adequate.

This comment points no great lesson, nor can it lead to fewer errors. It is rather a skeleton at the feast intended to remind of matters of frailty and tenure.

## PRACTICAL ENGINEERING

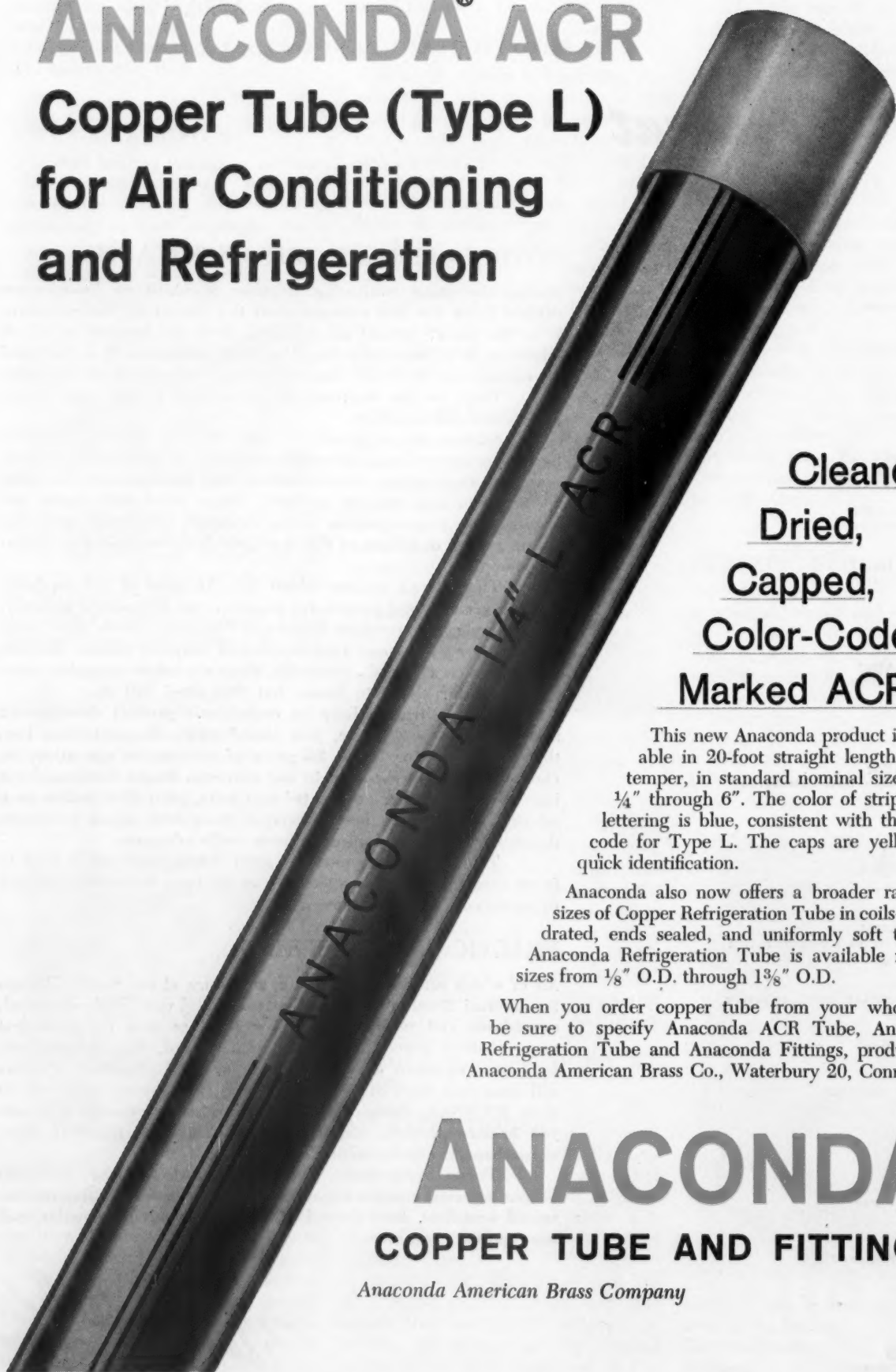
All of which reminds us of the Symposiums at our recent Chicago Semiannual Meeting where, well-attended and vigorously discussed, procedures and problems gained precedence over the somewhat more abstract aspects of engineering. Indeed, Symposiums have long been excellent drawing cards at ASHRAE Meetings. Readers will find that most of the papers presented appear ultimately in their JOURNAL, though space limitations and maintenance of subject balance preclude simultaneous publication of many of them, or, perhaps, the inclusion of all at any time.

These Symposiums fall literally between the Technical Session material and the Forums; the latter, of course, being off-the-record occasions, least formal of national meetings activities, and not reported upon ever.

*Edward R. Searles*  
Editor

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# What about 25 years from now

## *In the Heating Industry?*

Before taking a look at the heating industry of 25 years from now, let us concede that most major changes of the future will depend, to a marked degree, on the international political atmosphere of the next eight to ten years and to the extent that we are permitted to utilize and augment the peacetime use of atomic energy. This latter, alone, may well be the most significant influence in advancing any projection for industry change and growth.

Based on the premise that we will have a relatively free hand in these efforts, let's take a look at the heating industry, as we see it, 25 years hence.

### Heating system designs:

High temperature hot water heat transfer will be commonplace and used in all major commercial and industrial markets. It will also establish some acceptance for use in the domestic home market.

Solar heating for domestic use will become competitive with wet heat. By this time, newly-developed capacitors will store solar energy for use on a cloudy day.

Electric heat will be used primarily in new home construction since only a limited amount of atomic energy or electrical power transmission will be available.

Forced air heating will dwindle to a replacement market business comparable to what the stoker industry is today. Likewise, the heat pump will never achieve its current potential because of other energy sources more readily available.

Steam for use in low pressure heating systems, also faced with a declining market, possibly will be used primarily in the replacement boiler market. High temperature hot water boilers will be common-



H. F. HOLTZ

place for year around use for cooling in the summer and heating in the winter.

### Fuels:

Current indications are that gas will reach its peak in use for heating and start a gentle downward movement. A crest of 65 to 70% of the total heating market for gas is a likelihood.

Fuel oil by this time will account for less than 10% of our total heat producing fuel. Coal should be mentioned since it is in use today, mostly in central station or power station work. By 1986, it probably will not be a major heat source utilized in this field.

Electricity or electric power from peacetime atomic development will be growing at a rapid rate, limited only by the availability of transmission lines. Conceivably, 15 to 20% of home heating in 1986 will be with electricity.

The balance of the market will include solar systems, the heat pump and possibly other new forms of heating. Combined, these techniques will account for a small percentage of 5 to 10%.

### Fuel burning equipment or fuel burner:

Oil and gas burners, completely redeveloped and redesigned

by this time, will use a turbine type design with few moving parts, will be low in maintenance costs and have many of the advantages of today's jet engine.

Atomizing of heavy fuels will also have been solved by the use of high frequency sound waves.

Again, for those who produce heat with atomic energy, electric heating will be growing limited primarily by transmission difficulties.

### Materials:

By 1986, there will be many changes, many new things to consider. For example, in boiler and pressure vessels non-corrosive metals and even plastics will be used, which will practically eliminate oxygen or scale corrosion problems.

Steel and cast iron pipes will compete strongly with new plastics and styrene by-products for this type of business.

There will be a whole new series of metals for lighter, stronger and again, non-corrosive use in burners, controls and accessories.

New construction materials, along with new concepts of construction, will change methods in determining heat losses, which even today are archaic. New constructions will make full use of internal illumination and elimination of heat loss through window areas. Homes, office buildings, and other structures will include areas or rooms designed for year around sun viewing and better health standards. Along this line, there will be central station heating and cooling sections, the forerunner of an atomic power station furnishing all the energy for heating and cooling for a specific area, possibly as much as a square mile.

In the control field, electronic

(Continued on page 58)

H. F. Holtz is Vice President, Cleaver-Brooks Company.

# Sizing of refrigeration system pipelines for Optimum Economy

Most methods of pipe sizing for refrigeration systems have been based on allowable pressure drop or else a suitable range of velocity of flow, to result in reasonable economy and operating conditions; reasonable insofar as the annual investment cost of the piping as installed, together with the pumping cost to overcome friction losses of the fluid flowing, would be near a minimum total cost of owning and operating the system.

Since the cost of electricity per kw hr has been decreasing gradually as time progresses, while the manufacturing and raw material costs for piping as well as installing labor costs all have risen considerably in recent years, a review of the economics of pipe size selection for electric motorized refrigeration systems is thought to be opportune.

As a consequence, a series of pipe selection charts, which are based on a combination of analytical and graphical methods of analysis of the economic parameters affecting the optimum sizing of refrigeration pipelines, has been devised and they are presented herein. It is felt that both charts are flexible, in that they allow for changing economic conditions as well as being complete in their inclusion of the major factors that should be considered in the selection of pipe sizes for optimum economy.

## REVIEW OF ECONOMIC ITEMS INVOLVED

Fig. 1 illustrates schematically the economic pattern involved in pipe size selection. Curve "A" shows how the cost of overcoming friction

Donald J. Renwick is Associate Professor of Mechanical Engineering, Michigan State University. This is a condensed version of a paper presented at the ASHRAE Semiannual Meeting, Chicago, Ill., February 13-16, 1961. The full paper is planned for inclusion in the ASHRAE 1961 TRANSACTIONS.



DONALD J. RENWICK  
Member ASHRAE

will decrease as the diameter of pipe is selected toward larger sizes. This pumping cost will accrue from the extra work of running the compressor in order to maintain fluid flow through the pipe lines and can be evaluated in terms of added cost of electricity for any electric motor driven compression type of system.

Curve "B" represents the typical trend of installed pipe cost, which naturally increases as larger diameters are selected. The total cost, represented by Curve "C,"

which is obtained by adding Curves A and B together, illustrates that a definite minimum cost or optimum diameter will occur. Several parameters influence what this optimum diameter should be in any given design and a mathematical-graphical method now will be developed for determining the diameter of both suction and discharge lines of refrigeration systems for several popular refrigerants.

The fundamental analysis and development of a method for pipe sizing proceeds as follows:

Total annual cost = cost of fluid friction per year + annual investment cost of pipe as installed

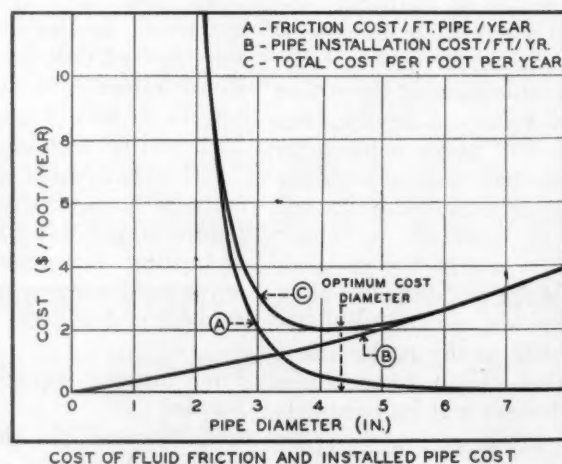
Work of fluid friction =  $\Delta P v w$   
(in ft-lb per sec)

Cost of fluid friction per year =  
 $8760 \Delta P v w U_r E$  (in ¢/year)

$\Delta P = \frac{f L \rho V^2}{2gD}$  = Fanning equation  
for friction loss in lbs per ft<sup>2</sup>

$f = \frac{0.184}{(R_e)^{.1}}$  = Pipe friction factor  
for copper tubing

$f = \frac{0.23}{(R_e)^{.1}}$  = Pipe friction factor for



steel tubing (estimate at 25% higher than for copper)

$$R. = \frac{dV\rho}{0.00806\mu} = \text{Reynolds number}$$

$d$  = Inside pipe diam in.,  $D$  = diam ft  
 $L.$  = Equivalent length of piping system, ft

$L$  = Actual length of piping system, ft  
 $\rho$  = Density of fluid in lb per cu ft

$R.E.$  = Refrigeration effect in Btu lb

$T$  = System capacity in ton

$$V = \frac{576 w v}{\pi d^2} = \text{Fluid velocity in fps}$$

$v$  = Average specific volume of fluid in cu ft per lb  
 $T \times 200$

$$w = \frac{60 \times R.E.}{T \times 200} = \text{lb of fluid per sec}$$

$E$  = Electrical cost in cents per kw hr

$\eta_o$  = Overall isentropic compression and motor efficiency combined (%/100)

$U_r$  = Usage factor as fraction of year running time (%/100)

$\mu$  = Fluid viscosity in centipoises

8760 = hr per year

738 = Converts ft-lb per sec to kw

Making all the appropriate substitutions as indicated above and combining constants, the cost equation then becomes:

$$\text{Total annual cost} = \frac{5.37 \times 10^4 \mu^{1.25} v^2 T^{2.5} E L. U_r}{(R.E.)^{2.5} \eta_o d^{4.5}} + L \times$$

Graph of installed pipe cost—¢ per ft per yr basis

Now to determine the optimum diameter, the above equation should be differentiated with respect to diameter and the result set equal to zero, thus:

$$\frac{\partial}{\partial d} (\text{Total Cost}) = 0 =$$

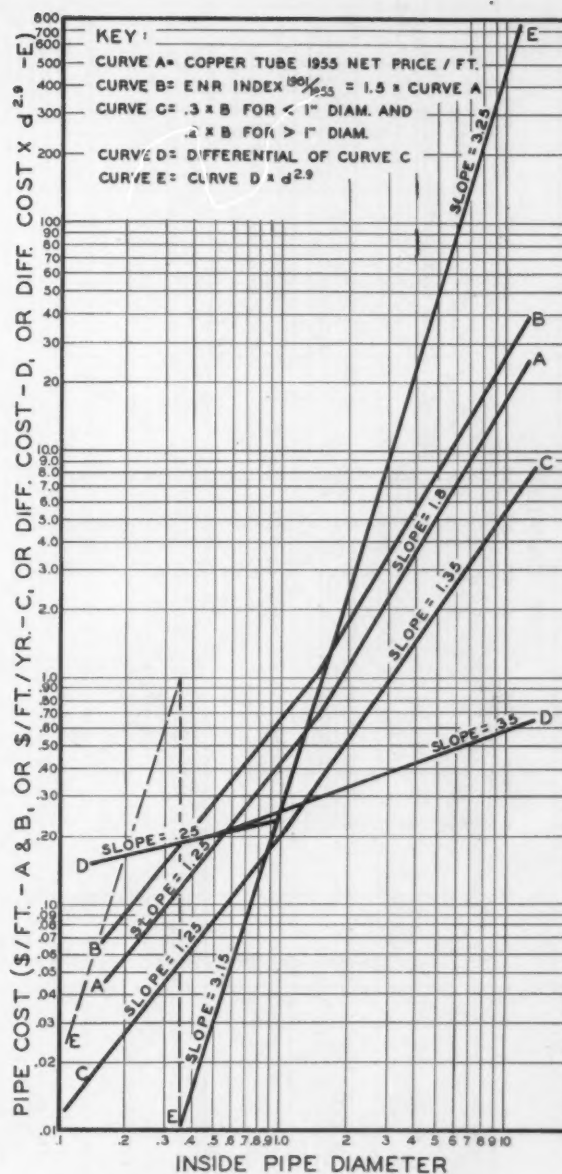
$$\frac{2.58 \times 10^5 \mu^{1.25} v^2 T^{2.5} E}{(R.E.)^{2.5} d^{4.5}} \frac{L. 1}{L \eta_o} U_r +$$

Graphically differentiated cost of pipe per foot

which in effect indicates that the diameter will be optimum when the differentiated value of the friction cost term exactly equals the differentiated term for installed pipe cost.

This last term of the equation (for installed pipe cost) more conveniently is handled graphically and is so indicated above, since there is no universally simple equation or expression for the installed cost of piping based on variation with diameter. Several references (notably 3, 4 and 5) show graphical presentations of pipe cost and clearly illustrate the natural rising trend of cost with increasing diameter, similar to Curve A of Fig. 2.

Fig. 2



Then the Appendix presents a method for differentiating such a curve and adapting it to the charts presented here for optimum pipe size selection.

#### CONSTRUCTION AND USE OF PIPE SELECTION CHARTS

Figures 3, 4 and 5 illustrate pipe size selection charts for Refrigerants 12 and 22 and ammonia, respectively. The sloping lines labelled "copper-type L" and "steel-sched. 40" represent the effect of installed cost of either copper or steel piping and are located (as referred to above) by the method outlined in the Appendix from Curve D of Fig. 2. These pipe cost lines occasionally may need to be relocated, but only at times of appreciable pipe cost changes.

The rest of the chart is con-

structed to allow for each of the parameters contained in the first term of the pipe cost equation (i.e., for friction loss). While this term appears to be complicated, it is mathematically exact and the several parameter effects, when once located by proper scales on the chart, are good for all time and never need to be changed. Some engineering judgment will, of course, be required to estimate suitable values to use for each of these parameters in a given design situation.

#### ARRANGEMENT OF CHART SCALES

The three fluid properties, viscosity ( $\mu$ ), specific volume ( $v$ ) and refrigeration effect ( $RE$ ) all depend on the refrigerant used as well as the cycle operating conditions,



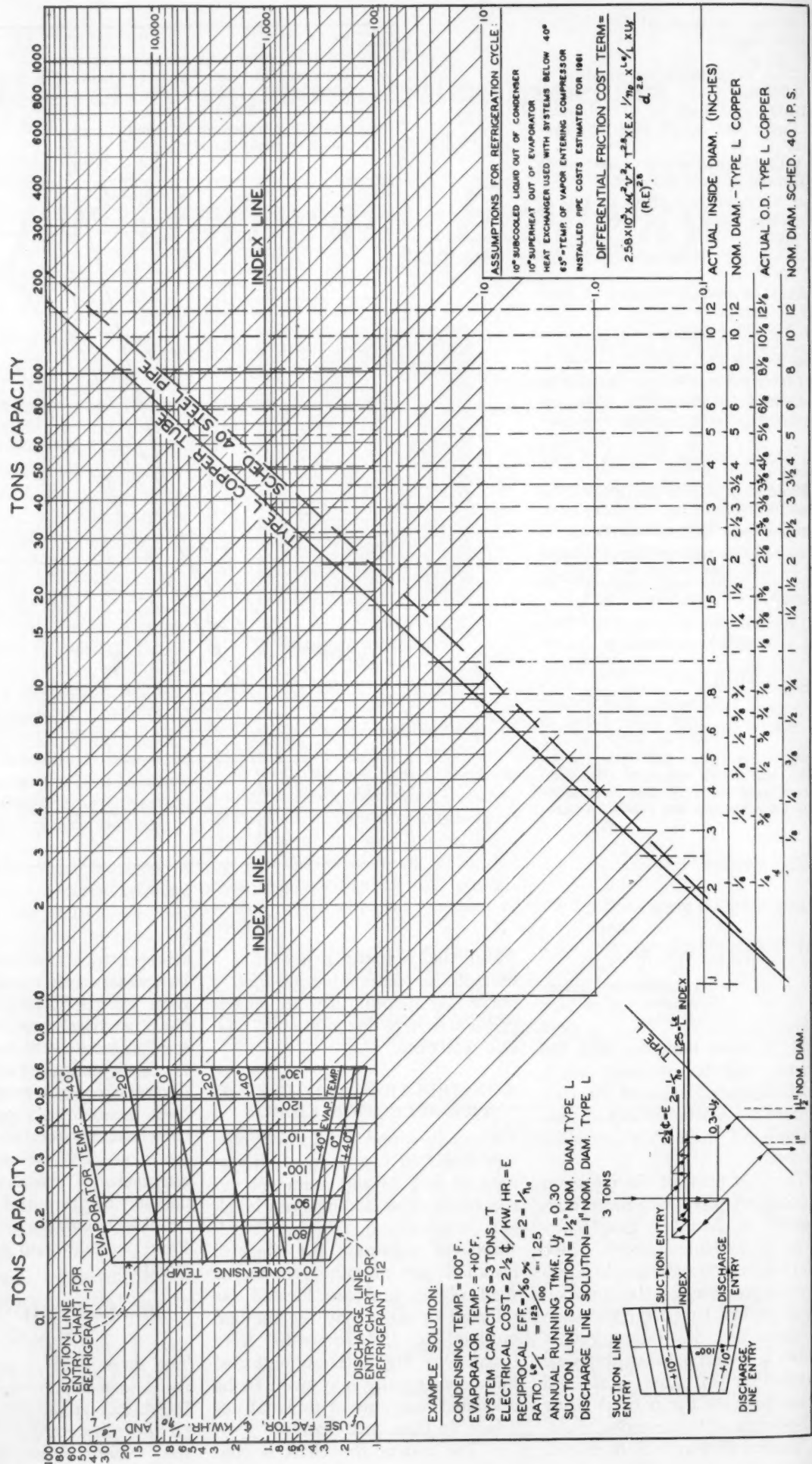


Fig. 3

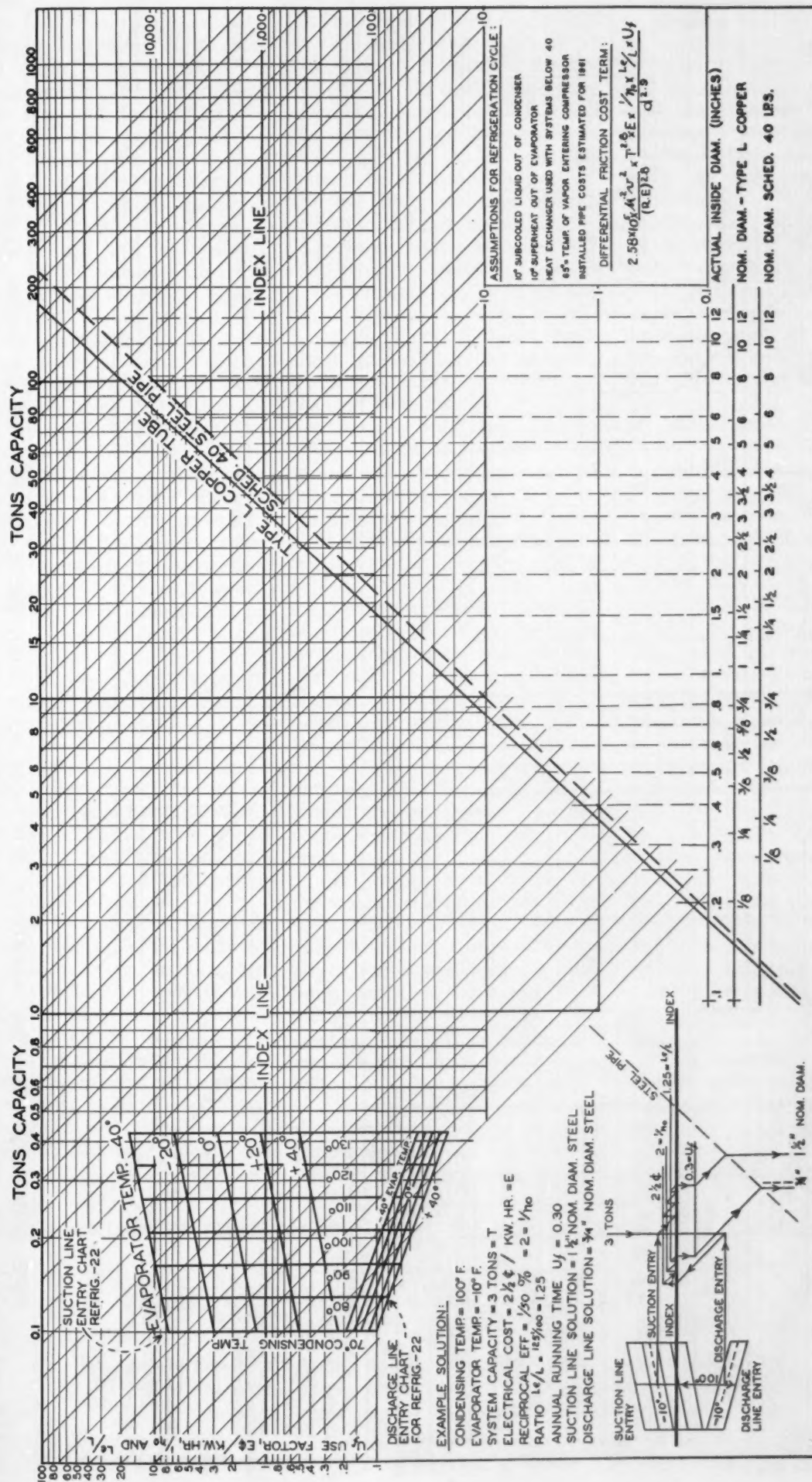


Fig. 4

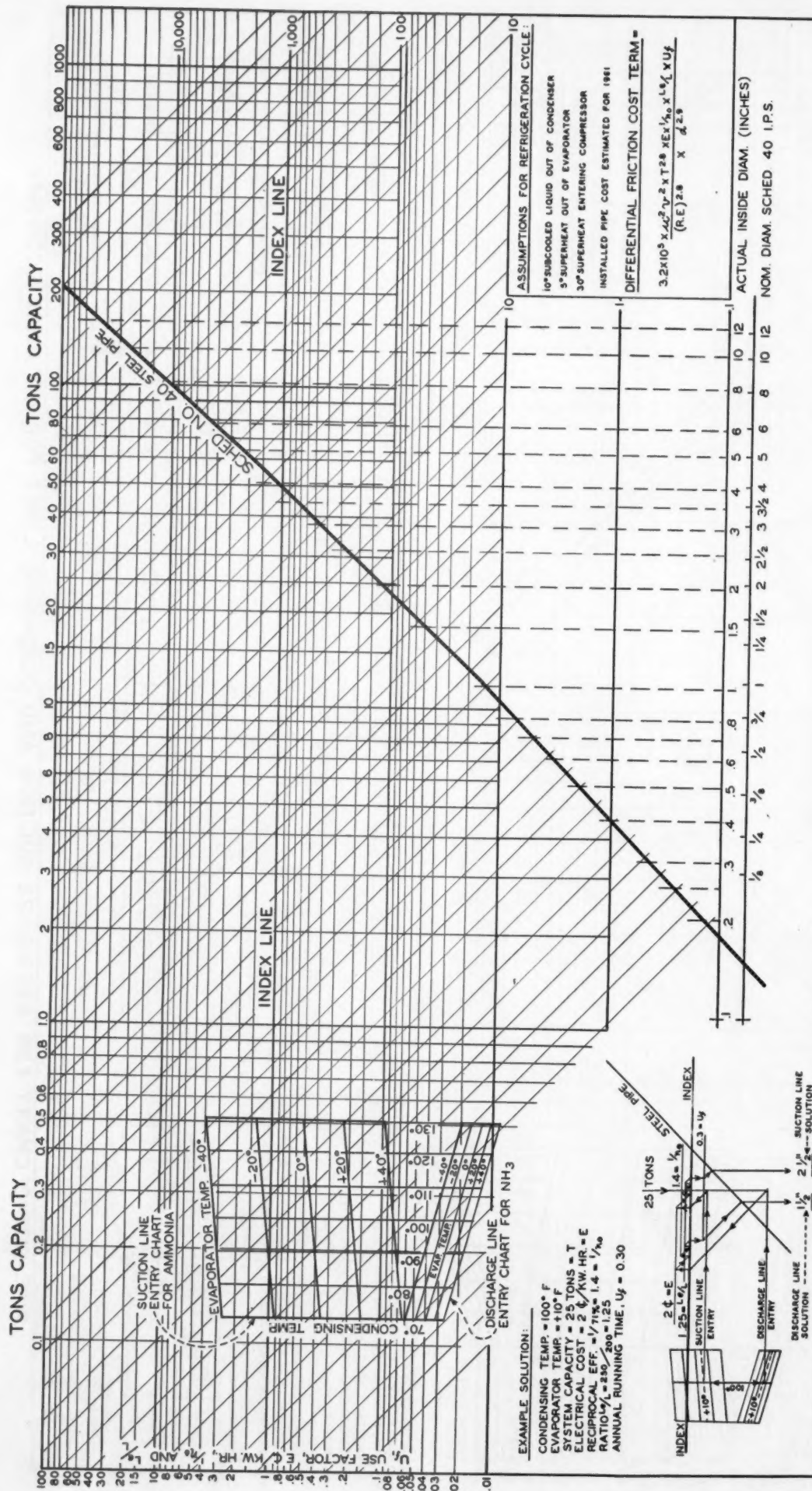


Fig. 5



especially the evaporator and condensing temperature. Their combined effect, together with the formula constant of  $2.58 \times 10^5$ , are included in the location of the operating conditions part of the chart (toward the upper left corner). Next, the system capacity is taken care of by the horizontal tonnage (T) scale along the top of the chart, and this log scale is stretched 2.8 times the vertical log scale to account for the 2.8 exponent of T.

The electrical cost (E), the equivalent length ratio ( $L_e/L$ ), the reciprocal of overall efficiency ( $1/\eta_o$ ) and the use factor ( $U_t$ ) are all taken care of as multiplying parameters by using the vertical log scale for addition adjustments at the index line for the effect of each parameter taken in successive order. Finally, the 45-deg guide line is followed to its intersection with the pipe cost line, at which point the optimum diameter can be read as the solution directly below.

#### CHOOSING VALUES FOR PARAMETERS IN COST EQUATION

Starting again at the chart entry condition (upper left), further details of the choice of suitable values to use for each parameter now will be discussed from the standpoint of factors involving engineering judgment and decisions.

In determining the refrigerant property parameters, the refrigeration cycle operating conditions first have to be decided upon or estimated. For these charts the following cycle conditions were assumed: (1) A single stage compression system with evaporator temperatures ranging from  $-40$  to  $+40$  F and condensing temperatures from  $+70$  to  $+130$  F; (2) Liquid entering the expansion valve at 10 F subcooled;

(3) Vapor leaving evaporator with 10 superheat for Refrigerants 12 and 22, but 5 F superheat for ammonia; (4) Suction temperature entering compressor at 65 F for all Refrigerant 12 and 22 systems but 30 F superheat for all ammonia systems, because (5) a liquid to suction line heat exchanger was assumed for all Refrigerant 12 and 22 systems which were below 40 F evaporator temperature, but no heat exchanger for any of the ammonia systems.

Since there is some doubt about the advisability of using liquid to suction line heat exchangers in Refrigerant 22 systems (see Reference 2, chap. 53), the entry constant was calculated for cycles both with and without the heat exchanger present; however, the difference is negligible, so the chart entry constants are based on cycles with the heat exchanger included. Table I lists sample values for the three refrigerant properties of viscosity, specific volume and refrigeration effect, with the final chart entry constant as calculated. He still can enter the chart by calculating his own value of  $2.58 \times 10^5 \mu^2 v^2 \div (RE)^{2.8}$  and then use the vertical numerical scale for entry along the left hand side and ignore the refrigerant operating temperature conditions part of the chart.

It may be noted above that the viscosity parameter has a conspicuously weak effect, since it varies from about 0.01 to 0.02 centipoises over a wide range of operating conditions, and then after taking the 0.2 power, the result comes close to 0.42 for both suction and discharge lines, for most refrigerants.

Specific volume squared is, on the other hand, a highly important parameter to obtain as closely as possible, because of its wide range

of variation with different operating conditions, which when squared increases the magnitude of effect still more. However, its value can easily be obtained with sufficient accuracy by reference to a standard Mollier (P-H) chart for the refrigerant used once the operating conditions have been established for reference.

Refrigeration effect is also important since it is raised to the 2.8 power, but again the Mollier chart serves adequately and indicates a possible range of 40 to 60 for Refrigerant 12 (or 60 to 80 for Refrigerant 22 and about 420 to 520 for ammonia) over the range of operating conditions assumed above.

To illustrate further with a numerical example, assume a Refrigerant 12 system with R.E.=50 Btu/lb and specific volume = 4 cu ft/lb, and viscosity = 0.015 centipoises; then the chart entry constant would be  $2.58 \times 10^5 \times (0.015)^2 \times 4^2 \div 50^{2.8} = 31.1$ . This would be true for smooth copper tubing as used typically with Refrigerant 12 and 22 systems, but if steel tubing were used, then the friction factor can be approximated at about 25 to 60% higher, according to some authorities (refer. 13 and 17) and assuming the 25% increase here, would result in a formula constant of about  $3.22 \times 10^5$  instead of  $2.58 \times 10^5$ ; thus the chart entry constant would increase to 38.9 instead of 31.1. Ammonia systems, of course, use ferrous pipe only and there is no need for copper pipe information on the ammonia pipe selection chart.

For either the Refrigerant 12 or 22 charts, where both copper and steel piping lines appear, the 25% difference in friction factor is allowed for by basing the chart entry constant on the friction factor

TABLE I — VALUES OF REFRIGERANT PARAMETERS FOR FRICTION COST CHART CONSTANTS

REFRIG- ERANT & PIPE MAT.	Refrig. Effect $h_2-h_1$ (Btu/lb)	(R.E.) <sup>2.8</sup>	Suction Line			Discharge Line			Chart* Constant		
			Visc. $\mu$ (cent)	Spec. Vol. $v_s$ ft <sup>3</sup> /lb	Chart* Constant $(V_s)^2 \phi_1 (\mu_s)^{-2} (v_s)^2$ (R.E.) <sup>2.8</sup>	Visc. $\mu_d$ (cent)	$(\mu_d)^{-2}$	$v_d$	$(v_d)^2 \phi_2 (\mu_d)^{-2} (v_d)^2$ (R.E.) <sup>2.8</sup>		
12 Cu	55.3	$0.756 \times 10^5$	0.0125	0.416	1.87	3.5	4.97	0.0155	0.435	0.40	0.160 0.237
22 Cu	73.2	$1.67 \times 10^5$	0.0125	0.416	1.60	2.56	1.65	0.0165	0.440	0.36	0.130 0.064
NH <sup>3</sup> Steel	471	$305 \times 10^5$	0.0098	0.397	9.9	98.0	0.410	0.0153	0.434	2.20	4.84 0.022

NOTES: \*  $\phi_1 = 2.58 \times 10^5$  for copper lines  
 $\phi_1 = 3.22 \times 10^5$  for steel lines  
 See Fig. 7 for refrigerant cycle subscripts  
 Cond. temp = 100 F and Evap. temp. = 0 F

$h_1$  assumed at 84 Btu/lb for Refrigerant 12 at all evap. temps.  
 and  $h_2 = 110.5$  Btu/lb for Refrigerant 22 because of heat inter-  
 changer effect.  $h_1$  taken for 10 F subcooling of liquid.

for copper and then locating the price line for steel 25% lower than indicated by the pipe cost analysis procedure in the appendix. For ammonia systems the friction factor is figured directly at 25% higher in determining the effect of the fluid properties on the chart entry values.

Thus, any of the three charts can be used for any refrigerant other than Refrigerants 12 and 22, or ammonia, and also for any modification of the given refrigerant cycle, provided one allows for the proper pipe material friction factor and calculates his own chart entry constant for the refrigerant and system cycle conditions chosen.

Each engineer would probably develop his own opinion as to suitable estimating values to use for  $E$ ,  $L_e/L$ ,  $1/\eta_o$ , and  $U_t$ . For instance, 2c per kw hr is close to the national average for electricity but this varies frequently from 1/4c to 5c per kw hr or more in different localities. The important consideration here would be to estimate the average price that the user of the system will be paying for electricity to operate his system under average installed conditions and taking into account the price schedule established by the local utility for such electrical usage and demand. Along this same line, when considering the price of pipe in order to locate the pipe cost line (as described in the appendix), it is important to estimate the actual price that the purchaser of the system is to pay for the piping as installed, including the effect of possible price discounts for quantity orders, cost of fittings and installing labor costs.

The overall efficiency,  $\eta_o$ , is the isentropic compression and motor efficiency combined and usually varies from about 65% isentropic compression efficiency  $\times$  70% motor efficiency, which equals 45% overall efficiency for small systems of less than one-ton capacity, through approximately 80%  $\times$  85% = 68% efficiency for medium sized systems of 1 to 20-ton capacity, up to possibly as high as 90%  $\times$  95% = 85% efficiency for large systems of 100 or more ton capacity. This results in the reciprocal of efficiency values,  $1/\eta_o$ , ranging from about 2.25 to 1.2.

The usage factor,  $U_t$ , will vary

from possibly 900 hr/yr (or about 10%) for air conditioning systems in northern U. S. climates, through about one-third running time (or 33%) for average food refrigeration systems to, possibly 75 or 80% for some special purpose, almost continuous running industrial air conditioning or refrigeration systems.

#### EFFECT OF PIPE LINE LENGTH ON SIZE SELECTION

The ratio of equivalent length of the pipe line system to the actual length ( $L_e/L$ ) might fall in the range of 1.25 for a medium length or even a long piping system with an average number of fittings consisting of six elbows and one shut-off valve. Or  $L_e/L$  could be as great as 2 in a short piping system with a relatively large number of fittings, especially for a closely coupled system of large pipe diameter. Thus, when the adjustment is made on the chart for some estimate of  $L_e/L$ , one actually is allowing for the increased energy cost due to the extra friction of fittings and valves. However, no allowance has been made yet in the analysis for the specific volume increase due to the total line pressure drop, which results in an added increment of cost for the relative increase of compressor displacement requirement as pipe lines become longer.

A possible way to check the magnitude of this volume increase

effect might be to estimate the added cost of a greater displacement compressor in terms of larger dimensions just to compensate for the volume increase due to pressure drop. Or another way would be to increase the compressor rpm sufficiently to handle the volume increase with no loss in system capacity and then shorten the compressor life a proportional amount. In either case, this would have the effect of a greater annual investment cost for the compressor, compared to the cost of the pipe lines, and could be allowed for by adding an increment of cost to the friction side (or the electrical cost term) of the equation.

For instance, over a wide range of evaporator conditions it can be shown (see Appendix) that the amount of pressure drop per 100 equivalent ft of pipe length will increase the specific volume of vapor flowing in either a suction or discharge line by usually less than 10%. Then, whether a larger displacement compressor (dimensionally) be chosen to compensate for suction line  $\Delta P$ , or if capacity be retained by a 5% increase in rpm and hence a shorter operating life, either way results in about a 5% increase in compressor investment cost.

An investigation of a few price lists for compressors (only) indicates that a typical cost might be of the order of \$50 to \$100 per ton capacity; then on a 15 year life basis this would convert to an annual investment cost of about \$5 to \$10 per ton, and 10% of \$10 would be \$1 additional compressor investment cost per year per ton for each 100 equivalent ft of pipe. Meanwhile, the electrical operating cost at a typical rate of 2c per kw hr and 1 kw hr per ton-hr as estimated for air conditioning operating conditions, and one-third running time annually, would amount to an estimated annual operating cost of 2c  $\times$  3000 hr  $\times$  1 = \$60 per year per ton capacity. \$1 (or even \$1.20) would, at the most, be equivalent to not over 2% (and as low as 0.2%) in increased electrical operating cost for each 100 equivalent ft increase in pipe length. And the pipe selection charts clearly indicate this is a negligible quantity. This is, indeed, one of the major conclusions of this whole analysis; i.e., that the occasional practice of

TABLE II — COMPARISON OF SUCTION LINE SIZES BY  $\Delta P$  ALLOWANCE VERSUS OPTIMUM ECONOMY

REF. RIG.	TON CAPACITY			
	100 F COND. (SUCTION LINES AND OF EVAPORATOR)			
	PIPE SIZE TYPE L-OD	0 F EVAPORATOR ASRE $\Delta P = 1.01$	Opt. Econ. 2c/kwhr	$\Delta P$
12	1/2	—	0.24	2.31
	1 1/8	1.39	1.75	1.29
	3 1/8	22.70	18.00	0.54
	6 1/8	137.0	91.0	0.34
Steel Sch. 40 $\Delta P = .78$				
NH <sub>3</sub>	1	3.46	3.4	0.90
	3	73.9	42.0	0.38
	6	445	200	0.24
	12	2640	920	0.14

NOTES:  $\Delta P$  values are psi per 100 equivalent length of pipe.

For optimum economy basis:

$U_t = 30\%$   $L_e/L = 1.25$

$\pi_o = 50\%$  for small systems and  $\pi_o = 85\%$  for large systems



oversizing unusually long piping systems by one or two pipe sizes is out of proportion for optimum economy conditions.

It should be pointed out here that compressor speed changes are frequently impossible to make due to the increasing popularity of direct drive motor-compressor units. Furthermore, small incremental adjustments of compressor displacement by dimensional changes (as low as 5% steps) almost never are encountered within the line of compressors available from a single manufacturer. Hence, even though the methods suggested above for adjustment of compressor displacement are seldom feasible, yet it is one way to approximate the relative worth of refrigerant volume increase due to pressure losses in pipelines.

#### RELATIVE EFFECT OF PARAMETERS ON PIPE SIZE

Finally, consider the effect of the remaining parameters on pipe size, some of which do have a considerable effect and are seldom allowed for in present pipe tables. Inspection of the pipe charts here will indicate that it takes about a 3 times multiplication of any vertically located parameter to require a change of one pipe size. Thus, use factor, or electrical cost, or efficiency, or equivalent length ratio, or installed pipe cost would each have to change by a factor of 3 individually, or by a collective factor of 3 due to any total combined effect, to cause one pipe size change. Similarly it takes about 15 to 20 F change in evaporator tem-

perature to call for one pipe size change of suction line, but the same is not true for discharge lines where evaporator temperature variation has a minor effect.

Changes in condensing temperature have a minor effect in both lines and it is of some interest to note that what little effect there is results in opposite trends for suction lines compared to discharge lines. Finally, it takes about a 1½ to 2 times change in capacity or tonnage to require one pipe size change.

#### COMPARISON WITH OTHER PIPE SIZING METHODS

A comparison now of the pipe sizing method presented here with existing pipe selection tables is of interest. Table II shows such a comparison based on excerpts from the pipe sizing tables in the latest editions of the ASRE Data Books (Design Volume 10, 1957-58, and Application Volume 1, 1959). These tables are from ARI data converted to an equivalent  $\Delta t$  from the original pressure drop basis. It may be noted for the mid-range of pipe sizes (1 to 3 in.) that either method would indicate about equal capacity recommendations. But in the larger sizes of systems the optimum cost analysis would call for progressively larger diameter piping than is provided by the ARI schedule.

While different pressure loss allowances are often presented (References 1, 2, 11, 12, 14, 15, 16, 18, 20), the exact value to use in a given design situation is left up to the engineer, and little or no

information is given accompanying such tables as to the relative effect of the important economic parameters that should enter into the design selection. Such parameters as electrical cost, installed pipe cost, use factor and system efficiency all may have a combined effect of one or two-pipe size difference, which would require a sliding scale of pressure drop values to allow for these factors.

Fig. 6 shows how the pressure drop allowance and also the  $\Delta t$  equivalent should vary with pipe diameter for optimum economy (assuming the conditions listed above). It also shows the pressure drop required to maintain a velocity for adequate oil return in vertical upfeed risers (according to Holladay's analysis Ref. 15) and indicates a considerable safety factor in this respect of oil return for all sizes of Refrigerant 12 lines and at all temperatures, except for evaporator temperatures below -40 F, where there is little or no margin of safety.

#### PIPE SIZING FOR LIQUID LINES

Pipe sizing for liquid lines is not a question of optimum economy at all, but rather one of available pressure drop resulting from subcooling the liquid in the condenser, or in any heat exchange device, between the condenser and expansion valve where subcooling takes place (see References 2, 11, 12, 14, 17). The basis for design of liquid lines is that as long as the total pressure drop (due to friction of the fluid flowing in straight pipe plus fittings, as well as any head loss due to rise of liquid in any vertical runs) does not exceed the pressure drop equivalent for the degrees of subcooling of the liquid as it leaves the condenser and before it gets to the expansion valve, then the design will be satisfactory, since formation of flash gas before the expansion valve will be avoided. Consequently, the allowable pressure loss method is the accepted way to size liquid lines.

#### SUMMARY AND CONCLUSIONS

1. The analysis presented here includes the major factors which should influence pipe size selection. Some engineering skill and judgment still is needed to estimate

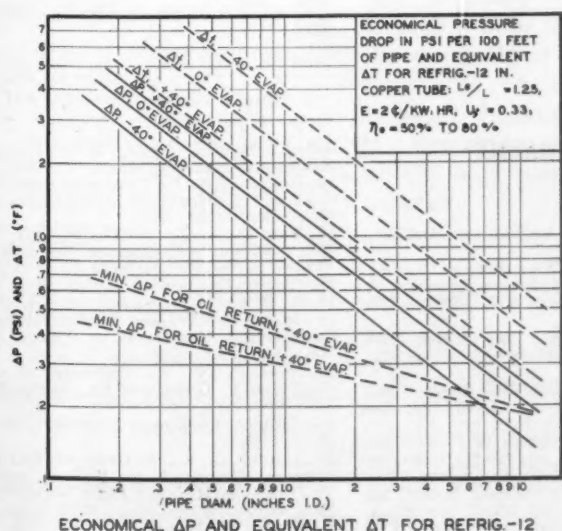


Fig. 6



suitable values for the several parameters in each design situation. However, the method here is quite flexible so the engineer may change conditions easily or compare alternate assumptions and note the relative effect or magnitude of any parameter change in question.

2. The customary pressure drop rules ranging in value from  $\frac{1}{2}$  to 3 psi per 100 ft for pipe sizing, as well as the  $\Delta t$  rule of 1 to 2 F per 100 ft, appear to result in economic pipe diameters for the mid-range

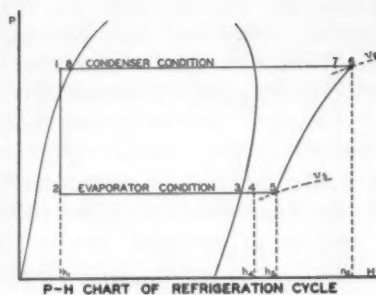


Fig. 8

of 1 to 3-in. sizes where typical

present-day prices are assumed. But for the larger diameters, the optimum cost method here would call for about one pipe size larger than would the recent ASRE tables based on one value of pressure drop.

3. The frequently quoted rule of one or two-pipe size increase for unusually long lines would not appear necessary from an optimum economy standpoint. The actual length of piping system should have little or no effect on the diameter selection.

#### CONSTRUCTION OF FIGS. 2, 3, 4 AND 5

To locate the pipe cost line on the pipe selection charts, the following method was used for copper tubing.

1. First, a graph was made of cost per ft of straight tubing versus pipe diameter on an actual ID basis. A 1955 price list was used and quantity purchase of 10,000 ft lot size was assumed. This located curve A in Fig. 2.

2. In order to estimate the 1961 price, the ENR index for refrigeration equipment was found to be about 211 for 1955 (Reference 22) and rising at about 17 points per year. Thus by 1961 the ENR index could be estimated at approximately 313. So curve B was located at about  $313/211 = 1.5$  or 50% higher than curve A.

3. Installation costs have been estimated at from 2 to 5 times the cost of straight pipe alone. Here a value of 3 times was assumed for sizes up to 1 in., and a value of 2 times at 6 in. diam. At the same time, based on an estimated life of 15 yr for the system and at 6% interest on the investment, the annual investment cost would be approximately 1/10 of the original installed cost. This located curve C at 3/10 of curve B for sizes less than 1 in. and 2/10 of B at 6 in. diam. Note that the slope of the curve C on log log plot is now 1.25 at less than 1 in. and 1.35 at over 1 in. diam.

4. Now to differentiate curves which are straight lines on log log plots, one reduces the original slope by one and multiplies the ordinate value at the intercept of unity on the abscissa scale by the slope,  $n$ , of the original curve. In this case, the differential of curve C to the left of 1 in. has a slope of  $1.25 - 1 = 0.25$  and crosses unity at  $0.20 \times 1.25 = 0.25$ ; and to the right of 1 in. the slope of curve D has a slope of 0.35 and intercepts unity at  $0.20 \times 1.35 = 0.27$ . Thus, curve D is the differential of curve C and could be transferred directly to the pipe selection chart as the solution line.

5. However, a few chart modifications were made next simply to improve the appearance, make the scales easier to read, and make the guide lines easier to follow. Since the friction term in the differentiated equation varies in magnitude inversely as  $d$  to the 5.8 power, one half of this power, or  $d$  to the 2.9 power, was taken as a multiplier of both terms. This makes the friction term vary inversely to the 2.9 power, and the differentiated pipe cost curve varies directly to the  $0.25 + 2.9 = 3.15$  power and  $0.35 + 2.9 = 3.25$  power, as shown for the slope value of curve E at values less than and greater than 1 in. diam, respectively. Finally, if the diameter scale (abscissa) for the pipe selection chart is chosen as 2.9 times the ordinate scales, then the guide lines will be at a slope of exactly  $45^\circ$  and the pipe cost solution line will be at a slope of

slightly over  $45^\circ$ , corresponding to slopes  $3.15 \div 2.9 = 1.08$  and  $3.25 \div 2.9 = 1.14$ , respectively to the left and right of 1 in. diam. Without the above modifications the guide lines would slope at a value of nearly 6 to 1, or after multiplying by  $d^{2.9}$  the slope would be 2.9 to 1, which is still too steep for easy reading and results in quite short diameter scale along the abscissa.

#### EFFECT OF PRESSURE DROP PER 100 FEET ON SPECIFIC VOLUME INCREASE

To check the effect of specific volume increase due to pressure drop per 100 ft of pipe line, refer to Fig. 6 again for the economical pressure drop recommendations. Note that for a 40 F evaporator and small pipe sizes the  $\Delta P$  per 100 ft of pipe is of the order of 3 psi for Refrigerant 12, which from saturated refrigerant vapor table results in a  $\Delta V$  of about 0.04 at a specific volume of 0.75, or about 5.3% volume change per 100 ft. At larger pipe sizes, the recommended  $\Delta P$  would be about 1/10 of the above value or  $\frac{1}{10}$  volume increase. Then at -40 F evaporator, the  $\Delta P$  per 100 is about 2 psi, which corresponds to a volume change of about 0.35 at a specific volume of about 3.5 cu ft/lb. This, then, is about a 10% volume increase for each 100 ft of pipe line and 1/10 of this value or 1% for larger pipe sizes.

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## Calculation of incident

# Low Temperature Radiation

## upon building surfaces

Heat flow to or from the interior of a building depends on the construction of the building, on the external air temperature and wind conditions, and on the net radiation exchange between the external surfaces of the building and its surroundings. The radiation exchange can be divided conveniently into two types—solar (short wavelength) radiation, and low temperature (long wavelength) radiation.

During daylight hours building surfaces receive solar radiation both directly from the sun and diffusely from the sky, the ground and other building surfaces by scattering and reflection of direct rays of the sun. The effects of solar radiation on heat flow to or from a building have been the subject of many papers in recent years; thus, this paper allies only with low temperature (long wavelength) radiation.

**Emission and absorption of low temperature radiation** — Any surface continuously emits low temperature radiation, given by

$$R_T = E \sigma T^4 \quad (1)$$

where  $R_T$  is the low temperature radiation emitted ( $\text{Btu ft}^{-2} \text{hr}^{-1}$ );

$E$  is the low temperature emissivity of the surface, defined for a specific temperature as the ratio of the emissive power of the surface at that temperature to the emissive power of a black surface at the same temperature;

$\sigma$  is the Stefan-Boltzmann constant  $= 0.173 \times 10^{-8} \text{ Btu ft}^{-2} \text{hr}^{-1}$

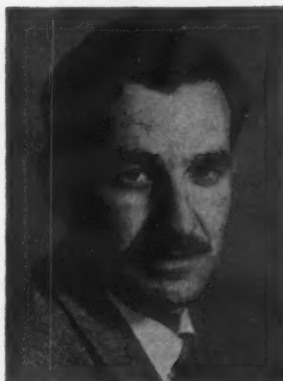
( $F_{\text{Abs}}$ )<sup>4</sup>;

$T$  is the surface temperature,

$F_{\text{Abs}}$

Tables of  $\sigma T^4$  are readily available<sup>1</sup>

Besides emitting low temperature radiation, a building surface



T. S. HOLDEN

will receive low temperature radiation from the sky, the ground and neighboring buildings.

The fraction  $A$  of the incident low temperature radiation which is absorbed by a surface, that is, the absorptivity, is by Kirchoff's law always equal to the emissivity of the surface for radiation of the same wavelength. The emissivities of most building surfaces are sufficiently constant for the range of low temperature radiation corresponding to temperatures encountered in practice, so that the absorptivity to incident radiation and the emissivity at ambient temperatures can be considered equal, although the incident and emitted low temperature radiations will not usually have identical spectral distribution.

**Sky radiation**—(a) Relation between sky radiation and humidity. The radiation emitted by a cloudless atmosphere has been correlated with absolute humidity by Brunt<sup>2,3</sup> who gives the empirical equation\*

$$R_s = R_{T_s} (a + b \sqrt{P_w}) \quad (2)$$

where

$R_s$  is the radiation received from the sky by a horizontal surface, in  $\text{Btu ft}^{-2} \text{hr}^{-1}$

$R_{T_s}$  is the radiation emitted by a black body at the air temperature  $T_a$ , in  $\text{Btu ft}^{-2} \text{hr}^{-1}$

$P_w$  is the water vapor pressure at ground level in inches of mercury

$a$  and  $b$  are constants

The factor  $(a + b \sqrt{P_w})$  in Equation (2) is thus equivalent to the emissivity of the sky.

This equation was based on systematic observations by Dines and Dines<sup>4</sup> extending over a period of six years, and on other similar observations. Brunt<sup>2,3</sup> also determined from Dines' data the variation, with elevation above the horizon, of the emissivity of different parts of the sky. Values of the constants  $a$  and  $b$  for radiation incident at various angles to the horizontal are given in Table I.

Brunt also suggested that  $b$  might be considered constant at

\* Brunt in fact uses  $e$ , the water vapor pressure in millibars, instead of  $P_w$ , and his values of  $b$  have been amended to allow for this change of unit.

Methods for calculating low temperature radiation to building surfaces from the sky, the ground and from neighboring buildings are here presented by the author. Emphasis is placed upon a method developed for the case of a building surface at any angle to the horizontal, with the ground at any slope.

T. S. Holden is with the Division of Building Research, Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia.



0.33, and that the empirical formula

$$\underline{a} = 0.64 - 0.14 \sin \phi \quad (3)$$

fitted the data with a high degree of accuracy, except for the zone nearest the ground. He concluded that this was due to the added effect of objects projecting above the ground.

The radiation from completely overcast skies is usually similar to that expected from a black body radiator at air temperature, but no quantitative rules can be given for other cases, other than that they lie between the overcast sky, which acts as a black body, and the clear sky described by Equation (2).

(b) Total radiation from all parts of the sky. The total low temperature radiation from a cloudless sky falling on a surface inclined at an angle  $\chi$  to the horizontal can be calculated by integration, as shown in Appendix 1. This yields

$$\begin{aligned} \underline{a} &= 0.32 (1 + \cos \chi) - 0.0297 \\ &\quad (\sin \chi + (\pi - \chi) \cos \chi) \\ \underline{b} &= 0.16 (1 + \cos \chi) \end{aligned}$$

and these values of  $\underline{a}$  and  $\underline{b}$  can be used then in Equation (2), which will include the effect of the surface facing only a portion of the sky. Values of  $\underline{a}$  and  $\underline{b}$  derived from these formulas are given in Table II for intervals of  $\chi$  of 15°. The value of  $\underline{a}$  of 0.551 given in Table I for the hemisphere was obtained by Brunt from independent observations by Dines and Dines (loc cit); the comparable value of 0.547 given in Table II for a horizontal surface facing up is based on integration of the other values given in Table I, hence the slight discrepancy.

If the horizon is obscured partly by the ground sloping up at an angle  $\beta$  to the horizontal in the vicinity of the surface (Fig. 1), the radiation can be calculated similarly, and this yields

$$\begin{aligned} \underline{a} &= 0.32 \{1 + \cos (\chi + \beta)\} \\ &\quad - 0.0297 \{(\pi - \chi - \beta) \cos \chi + \\ &\quad \cos \beta \sin (\chi + \beta)\} \\ \underline{b} &= 0.16 \{1 + \cos (\chi + \beta)\} \end{aligned}$$

If the angle between the ground and the surface is  $\gamma$ , that is,  $\gamma = \pi - \chi - \beta$ , then

$$\begin{aligned} \underline{a} &= 0.32 (1 - \cos \gamma) - \\ &\quad 0.0297 \{\gamma \cos \chi + \sin \gamma \cos \beta\} \\ \underline{b} &= 0.16 (1 - \cos \gamma) \end{aligned}$$

Values of  $\underline{a}$  from these formulas, at 15 deg intervals of  $\chi$ , are plotted

Table I—Coefficients  $\underline{a}$  and  $\underline{b}$  for Radiation Incident at Angles  $\phi$

Incident Angle ( $\phi$ )	$\underline{a}$	$\underline{b}$
0 - 15	0.774	0.29
15 - 30	0.581	0.34
30 - 45	0.548	0.32
45 - 60	0.522	0.32
60 - 75	0.508	0.33
75 - 90	0.498	0.34
Hemisphere	0.551	0.33

against  $\beta$  in Fig. 2. Corresponding values of  $\underline{b}$  may be found by entering Table II with  $(\chi + \beta)$  instead of  $\chi$ , and are also plotted in Fig. 2. The case of a vertical wall and level ground (i.e.  $\chi = 90$  deg and  $\beta = 0$  deg) yields values of

$$\begin{aligned} \underline{a} &= 0.290 \text{ and } \underline{b} = 0.163; \text{ Parmelee} \\ &\text{and Aubele}^* \text{ give } \underline{a} = 0.30 \text{ and} \\ \underline{b} &= 0.165 \text{ from a similar calculation} \end{aligned}$$

**Ground radiation**—Radiation will also be received by building surfaces from the ground, depending on the angle  $\gamma$  between the surface and the ground. If the ground is regarded as a plane of constant emissivity  $E_g$  and temperature  $T_g$ , the radiation  $R_g$  (Btu ft<sup>-2</sup> hr<sup>-1</sup>) incident on the building surface will be

$$R_g = \frac{1}{2} R_{T_g} (1 + \cos \gamma) \quad (5)$$

where  $R_{T_g}$  (Btu ft<sup>-2</sup> hr<sup>-1</sup>) is the radiation emitted by the ground at temperature  $T_g$ , and by Equation (1)

$$R_{T_g} = E_g \sigma T_g^4$$

The derivation of Equation (5) is given in Appendix 2.

**Total low temperature radiation on inclined surfaces**—The total low

Table II—Coefficients  $\underline{a}$  and  $\underline{b}$  for Plane Inclined at  $\chi$  to Horizontal

Inclination of plane ( $\chi$ )	$\underline{a}$	$\underline{b}$
0 (horizontal surface facing up)	.547	.326
15	.539	.320
30	.515	.304
45	.476	.278
60	.423	.244
75	.360	.205
90 (vertical surface)	.290	.163
105	.219	.121
120	.150	.081
135	.089	.048
150	.041	.022
165	.011	.006
180 (horizontal surface facing down)	0	0

temperature radiation on a building surface at angle  $\chi$  to the horizontal will be the sum of that received from the sky, the ground and neighboring buildings. In many cases it is sufficiently accurate to consider the ground as a uniform plane at an angle  $\beta$  to the horizontal and to use constants from Equation (4) (or Fig. 2) in Brunt's Equation (2) to evaluate the radiation from the sky, and to use Equation (5) for the radiation from the ground.

If the temperature or emissivity of the ground varies markedly, the ground must be divided into solid angle zones  $\delta\omega$  (steradian\*) sufficiently small for the accuracy required, and the contribution of each zone evaluated from

$$\delta R_g = R_{T_g} \frac{E_g \cos \alpha \delta\omega}{\pi} \quad (6)$$

where  $E_g$  and  $T_g$  are the emissivity and temperature respectively of the zone, and  $\alpha$  the mean angle of incidence of the radiation from the zone. Similarly, the effects of neighboring buildings can be calculated, allowing for any variations in the temperatures and emissivities of various parts. It is necessary, of course, to subtract the effects of portions of the sky or ground masked by such buildings by using

$$\delta R_s = R_{T_s} \frac{(0.64 + 0.33 \sqrt{P_w} - 0.14 \sin \phi) \cos \alpha \delta\omega}{\pi} \quad (7)$$

and Equation (6) for the ground, as before.

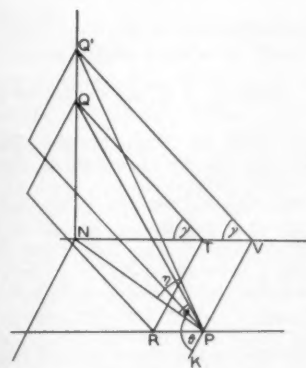
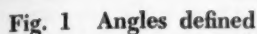
## NUMERICAL EXAMPLES

Two examples are given to illustrate the methods. For the first, consider radiation received by a "quarter pitch" (26° 34') roof, facing ground which has a mean temperature of 80 F, emissivity 0.9, and slopes up at an angle of 5 deg. Calculations are for 3 p.m., midsummer (December 22nd), with the roof facing north. The location is Melbourne, Australia (Lat. 37½° S), the air temperature 100 F and the relative humidity 10%, corresponding to 0.192 in. mercury water vapor pressure. For the sky radiation, Equation (2) yields

$$R_s = 170 (\underline{a} + \underline{b} \sqrt{0.192})$$

\* A unit square subtends a solid angle of 1/x<sup>2</sup> steradian at a point distant x units perpendicular from its centre.




$$\begin{aligned} \text{Equation (4) gives} \quad R_r &= \frac{1}{2} 0.9 148 (1 - 0.852) \\ &= 9.9 \text{ Btu ft}^{-2} \text{ hr}^{-1} \end{aligned}$$

Solar radiation	
Direct	210 Btu ft <sup>-2</sup> hr <sup>-1</sup>
Scattered	40
Low temperature radiation	
Sky	109
Ground	10
Total	<hr/> 369

**Fig. 2 Charted values for formula-derived figures**

The graph shows the relationship between  $\beta$  (for  $a$ ) and  $(x+\beta)$  (for  $b$ ) for various values of  $x$ . The left y-axis represents  $a$  (0 to 0.7), and the right y-axis represents  $b$  (0 to 0.35). The x-axis for  $\beta$  ranges from 0 to 180 degrees, and the x-axis for  $(x+\beta)$  also ranges from 0 to 180 degrees.

Curves are plotted for  $x$  values of  $0^\circ, 15^\circ, 30^\circ, 45^\circ, 60^\circ, 75^\circ, 90^\circ, 105^\circ, 120^\circ, 135^\circ, 150^\circ,$  and  $165^\circ$ . A dashed line represents  $b$  for values of  $(x+\beta)^\circ$ .

[illegible]

Solar radiation	0 Btu ft <sup>-2</sup> hr <sup>-1</sup>
Direct	25
Scattered	
Low temperature radiation	
Sky	41
Ground	88
Total	154

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$$R_s = 170 (.194 + 109 \sqrt{0.192}) = 41.3 \text{ Btu ft}^{-2} \text{ hr}^{-1}$$
$$R_g = \frac{1}{2} 0.9148 (1 + \cos (76 - 5)^\circ) = 88 \text{ Btu ft}^{-2} \text{ hr}^{-1}$$

APRIL 1961

## APPENDIX 1

### Sky Radiation on Inclined Planes

Brunt's analysis of the Dines' observations gives emissivities  $E_s$  of 15 deg zones of the sky centered on the zenith, in terms of  $P_w$ , the water vapor pressure in inches of mercury, considering the sky as an environment at air temperature, in the form

$$E_s = a + b \sqrt{P_w}$$

It is required to find values of  $a$  and  $b$  for equations of this form for the emissivity of the sky as a whole for plane surfaces at various angles  $\chi$  to the horizontal. Radiation  $dR$  incident on unit area of the surface from an element of the sky normal to its position vector  $r$  from the unit area, with angle  $\alpha$  between the position vector and the normal to the unit area, is given by

$$\frac{dR}{R_{Ts}} = \frac{E_s (\text{area of element}) \cos \alpha}{\pi r^2}$$

where  $R_{Ts}$  is the radiation per unit area from a black surface at air temperature  $T_a$ . Considering the emitting sky as a unit sphere, this becomes

$$\frac{E_s}{\pi} (\text{area of element}) \cos \alpha$$

If  $\theta, \phi$  are polar co-ordinates referred to the horizontal plane,

$$(\text{Area of element}) = d\theta d\phi \cos \phi$$

Thus  $dR$ , the radiation incident on the unit area from the element, is given by

$$\frac{dR}{R_{Ts}} = \frac{E_s}{\pi} \cos \phi \cos \alpha d\theta d\phi \quad (8)$$

Now  $\cos \alpha$  can be expressed in terms of  $\chi, \theta, \phi$ . Considering the spherical triangle  $ZNQ$  of Fig. 3, we have

$$\cos \alpha = \cos \chi \sin \phi - \sin \chi \cos \phi \cos \theta$$

$$\text{Thus } \frac{dR}{R_{Ts}} = \frac{E_s}{\pi} (\cos \chi \sin \phi \cos \phi - \sin \chi \cos^2 \phi \cos \theta) d\theta d\phi \quad (9)$$

$E_s$  can be expressed by

$$E_s = 0.64 - 0.14 \sin \phi + 0.33 \sqrt{P_w} \quad (10)$$

by combining equations (2) and (3), and hence

$$\frac{dR}{R_{Ts}} = \frac{1}{\pi} (0.64 - 0.14 \sin \phi + 0.33 \sqrt{P_w}) \cos \chi \sin \phi \cos \phi - \sin \chi \cos^2 \phi \cos \theta d\theta d\phi \quad (11)$$

The total radiation  $R$  can be seen from Fig. 3 to be

$$R = 2 \int_0^{\frac{\pi}{2}} \int_0^{\frac{\pi}{2}} dR + 2 \int_{\frac{\pi}{2}}^{\pi} \int_0^{\frac{\pi}{2}} dR$$

where  $\tan \eta = \tan \chi \cos \theta$ , from the spherical triangle  $ZQ'N'$ .

In the evaluation of these integrals, and similar integrals which arise in cases where the ground slopes, four functions occur, the values of which it may be useful to give as follows: If  $\tan v = \tan \mu \cos \theta$

$$\int_0^{\theta} \int_v^{\frac{\pi}{2}} \sin^2 \phi \cos \phi d\phi d\theta = \frac{1}{2} \cos \mu \text{ artan} (\tan \theta \cos \mu)$$

$$\int_0^{\theta} \int_v^{\frac{\pi}{2}} \cos \phi \sin^2 \phi d\phi d\theta = \frac{1}{2} \left( \theta + \frac{\sin \theta \cos^2 \mu}{\sqrt{(\cos^2 \mu - \sin^2 \theta)}} \text{arsin} (\sin \theta \sin \mu) \right)$$

$$\int_0^{\theta} \int_v^{\frac{\pi}{2}} \cos^2 \phi \cos \theta d\phi d\theta = \frac{1}{2} \left( \left( \frac{\pi}{2} - v \right) \sin \theta - \sin \mu \text{ artan} (\cos \mu \tan \theta) \right)$$

$$\int_0^{\theta} \int_v^{\frac{\pi}{2}} \sin \phi \cos^2 \phi \cos \theta d\phi d\theta = \frac{1}{2} \frac{\sin \theta \cos^2 \mu \cot \mu}{\sqrt{(\cos^2 \mu - \sin^2 \theta)}}$$

## APPENDIX 2

Low Temperature Radiation from Uniform Plane to Plane at an Angle

Referring to Fig. 4, P and Q are

points on the receiving and emitting planes, respectively, these planes being at angle  $\gamma$  to one another. It is required to find the radiation per unit area incident at P from the plane of Q. Let  $dP$  and  $dQ$  be elements of area, and  $N, M$  normals at P and Q, respectively.  $QL$  is perpendicular to plane P, and  $PK$  is parallel to the line of intersection of the two planes. Let  $\theta, \phi, r$  be polar co-ordinates of Q with reference to P as origin, and the angles  $\alpha, \beta$  are  $NPQ$  and  $MQP$  as shown.

The radiation  $dR$  incident on  $dP$  emitted by  $dQ$  is

$$I_Q dP dQ \cos \alpha \cos \beta \frac{r^2}{r^2}$$

where  $I_Q$  is the intensity of radiation emitted per unit area per unit solid angle at Q.

$\therefore$  Radiation incident per unit area at P from  $dQ$  is

$$I_Q dQ \cos \alpha \cos \beta \frac{r^2}{r^2}$$

now  $\alpha = \frac{1}{2}\pi - \phi$  so that

$$\cos \alpha = \sin \phi \text{ and } dQ \cos \beta = r^2 d\theta d\phi \cos \phi \therefore dR = I_Q \sin \phi \cos \phi d\theta d\phi$$

$$\therefore R = \int \int I_Q \sin \phi \cos \phi d\theta d\phi \quad (10)$$

Referring to Fig. 5, the P-plane, PRTVN, shown horizontal for convenience, intersects the Q-plane, QTR in TR. As before, QN is normal from Q to the P-plane. Plane PVQ' is drawn parallel through P to the Q-plane, intersecting NQ produced at Q'. The required limits of integration are  $\theta$  from 0 to  $\pi$  and  $\phi$  from 0 to  $\eta$ , where  $\eta$  is the angle Q'PN. Considering the right angled triangles NVP, Q'NP and Q'NV we have:

$$NP \sin \theta = NV = Q'N \cos \gamma$$

$$\sin \theta \tan \chi = \frac{Q'N}{NP} = \tan \eta$$

$$\cos \eta = \frac{1}{\sqrt{1 + \sin^2 \theta \tan^2 \gamma}} \quad (11)$$

If  $E_Q$  is the emissivity of the Q-plane, and  $R_T$  the black body radiation corresponding to  $T^\circ F$

$$\text{then } I_Q = \frac{R_T E_Q}{\pi}$$

Substitution into equation (10) yields

$$\frac{R}{R_T} = \frac{1}{2} E_Q (1 + \cos \gamma)$$

from which follows Equation (5).

ASHRAE

NATIONAL MEETINGS  
AHEAD

1961

June 26-28 68th Annual  
Denver, Colo.

1962

Jan. 28-Feb. 1 Semiannual  
St. Louis, Mo.

June 25-27 69th Annual  
Miami Beach, Fla.

1963

Feb. 11-14 Semiannual  
New York, N. Y.

June 24-26 70th Annual  
Milwaukee, Wisc.

# Some further thoughts upon the characteristics of design and performance of *Evaporative Condensers*

Basically, two parameters of state can be derived which characterize the operation of evaporative condensers:

$$H \equiv h' - h_1 = Q / [(1 - Z)G] \quad \text{Btu/lb} \quad (1)$$

$$T \equiv t_c - t'_s = Q / (UA) \quad \text{F} \quad (2)$$

Parameter  $H$  denotes the "effective enthalpy rise" of the air passing through the condenser; this parameter measures the specific enthalpy increase of that part  $(1 - Z)$  of the total air quantity  $G$  lb/hr which enters the condenser at enthalpy  $h_1$  and takes an active part in the process of heat dissipation by picking up the total available quantity of heat  $Q$  Btu/hr. The factor  $Z$  is the bypass factor.

As a heat carrier, the air quantity  $ZG$  is useless since it passes at too great a distance from the condenser coils; it but serves as a space filler in the duct and thus contributes toward a higher face velocity of the air with a resulting higher heat transfer coefficient to the effective part  $(1 - Z)G$ . Thus, viewed from the latter angle, the bypassed air makes at least an effort to pay for a certain part of its fanwork.

Parameter  $T$  denotes the so-called "surtemperature" of the condenser; it is the difference between the condensing temperature  $t_c$  and the so-called "equivalent wetted surface temperature"  $t'_s$  of an evaporative condenser dissipating the heat load  $Q$  Btu/hr through its surface  $A$  ft<sup>2</sup> with an overall heat transmission coefficient  $U$  Btu/hr ft<sup>2</sup> F.

In an ideal condenser with  $Z = 0$ , the total air quantity  $G$  takes an active part in the process



FRANCIS L. LEVY  
Member ASHRAE

and the air would be leaving at saturation temperature  $t'_s$  with relative humidity  $\phi = 1$ , and with the enthalpy  $h'_s$  of air saturated at  $t'_s$ . However, in reality the air leaves at  $t_2$  with relative humidity  $\phi_2 < 1$  (or at wet-bulb temperature  $t_{w2}$ ), and with the enthalpy  $h_2$  of unsaturated air. This result is caused by the active air part  $(1 - Z)$  of saturated enthalpy  $h'_s$  mixing with the bypassed air part  $Z$  which is still at its inlet enthalpy  $h_1$  corresponding to the temperature  $t_1$  and relative humidity  $\phi_1$  (or wet-bulb temperature  $t_{w1}$ ) of the ambient air.

**Enthalpy of Moist Air as a Temperature Function** — Within a temperature range from 50 to 105 F, the enthalpy of saturated air at

constant barometric pressure can be expressed with sufficient accuracy for the present purpose as a temperature function by an empirical equation of the general form

$$h' = h'_0 + \theta^2 / \epsilon \quad \text{Btu/lb} \quad (3)$$

In this and in subsequent equations, the temperature  $\theta = (t - 32)$  F is measured in degrees above ice point, and  $1/\epsilon$  (Btu/lb F)/F denotes the mean gradient of the specific heat of the air-vapor mixture within the temperature range under consideration. The constant  $h'_0$  would denote the enthalpy of saturated air at the ice point, if it were permissible to extrapolate Equation (3) beyond its lower temperature limit.

Based on the thermodynamic tables by Goff and Gratch [3] for saturated air at standard atmospheric pressure of 29.92 in. Hg, the numerical value\* of Equation (3) becomes

$$h' = 16.65 + \theta^2 / 84.21 \quad \text{Btu/lb} \quad (3a)$$

For other barometric pressures reference shall be made to numerical values quoted in the Appendix.

In turn, the thermodynamically correct notation of the enthalpy of saturated air is

\* While in the original paper numerical values were based on ASRE Data Book, 10th edition, those of the present version are based on the latest table values of ASHRAE Guide 1960. Readers will therefore observe slight discrepancies of the constants when comparing same with the author's original publication.

Since the publication of D. D. Wile's basic work on evaporative condensers [1, 2] the literature has become rather scarce. That author's concept of the principles involved has advanced greatly both theory and practice of construction.

The present paper seeks to provide further insight into the characteristic performance of evaporative condensers.

Dr. Francis L. Levy is a Consulting Engineer in London, England. This is an abridged version, by the author, of a similar discussion published in the "Journal of Refrigeration" (London) Vol. 3, No. 5, Sept./Oct. 1960.



$h' = 0.24\theta + 7.68 + r' (0.44\theta + 1,075.16) \text{ Btu/lb}$  (4)  
 where 0.24 Btu/lb F specific heat of dry air at constant pressure  
 0.44 Btu/lb F specific heat of water vapor at constant pressure  
 1075.16 Btu/lb latent heat of water vapor at  $\theta = 0$  ( $t = 32$  F)  
 $r'$  lb/lb specific humidity of saturated air at  $\theta = 0$  F  
 7.68 Btu/lb enthalpy of dry air at  $\theta = 0$  F

When writing Equation (3)  
 $h' = 0.24 + 7.68 + (h'_s - 7.68 - 0.24\theta + \theta^2/\epsilon)$  (3b)  
 the identity of the term in brackets and of the term  $r' (0.44\theta + 1075.16)$  in Equation (4) becomes obvious. Hence, the enthalpy  $h$  of moist air of relative humidity  $\phi$  can be written

$$h = 0.24\theta + 7.68 + \phi (h'_s - 7.68 - 0.24\theta + \theta^2/\epsilon) \quad (5)$$

and with the numerical constants of Equation (3a), valid for barometric pressures of 29.92 in. Hg

$$h = 0.24\theta + 7.68 + \phi (8.97 - 0.24\theta + \theta^2/84.21) \quad (5a)$$

The wet-bulb temperature of air  $\theta_w = t_w - 32$  can be defined as that temperature at which the correlated saturation enthalpy  $h'_{\theta_w}$  equals that of the moist air  $h_s$  at dry bulb temperature  $\theta$  and relative humidity  $\phi$ . Hence, according to Equations (3b) and (5)

$$0.24\theta_w + (h'_s - 7.68 - 0.24\theta_w + \theta_w^2/\epsilon) = 0.24\theta + \phi (h'_s - 7.68 - 0.24\theta + \theta^2/\epsilon) \quad (6)$$

from which, for a given dry-bulb temperature  $\theta$  and relative humidity  $\phi$ , the corresponding wet-bulb temperature becomes

$$\theta_w/\epsilon = (1 - \phi) [0.24\theta - (h'_s - 7.68)] + \phi \theta^2/\epsilon \text{ Btu/lb} \quad (7)$$

As the enthalpy of the saturated air at that temperature equals the enthalpy  $h_s$  of the moist air at correlated dry-bulb temperature  $\theta$  and relative humidity  $\phi$ , the enthalpy  $h_s$  can be expressed in terms of wet-bulb temperature by the equation

$$h_s = h'_{\theta_w} = h'_s + \theta_w^2/\epsilon \quad (8)$$

Of this equation use will be made presently.

**Relationship between condensing temperature, parameters and ambient air temperature** — Having established by Equation (3) the relation between saturation temperature and enthalpy, its application to Equation (2) leads to

$$\theta_c = T + \sqrt{\epsilon (h'_s - h'_s)} \quad (9)$$

Here,  $h'_s$  can be replaced by Equation (1):

$$\theta_c = T + \sqrt{\epsilon [H + (h_1 - h'_s)]} \quad (10)$$

In this equation, the enthalpy of the entering air  $h_1$  now can be expressed as the enthalpy at its wet-bulb temperature  $\theta_{1w}$  according to Equation (8), so that

$$\theta_c = T + \sqrt{\epsilon H + \theta_{1w}^2} \quad (11)$$

and for standard barometric pressure

$$\theta_c = T + \sqrt{84.21 H + \theta_{1w}^2} \quad (11a)$$

This equation can be used for many practical purposes and diagrams can be plotted showing the variation of  $(t_c - T)$  with the wet-bulb temperature  $t_{1w}$  of the entering air for various parameters  $H$ . Conversely,  $(t_c - T)$  can be used as a parameter and curves can be plotted for the variation of  $H$  with  $t_{1w}$ . Moreover, the values of  $U$  and  $Z$  on which the design of a condenser are based can be checked by testing a condenser at constant load  $Q$  while running it one time at  $(t_{1w})_1$  and another time at  $(t_{1w})_2$ , whereby reading the occurring difference  $\Delta_c = t_{c2} - t_{c1}$  of condensing temperatures. Since, at constant load, both  $T$  and  $H$  remain constant, Equation (11) yields

$$\Delta_c = \sqrt{\epsilon H + (\theta_{1w})_2^2} - \sqrt{\epsilon H + (\theta_{1w})_1^2} \quad (12)$$

from which  $H$  can be resolved and subsequently  $T$  with the aid of Equation (11). As during such a test both the load  $Q$  and the flow rate of air  $G$  have been read and the surface  $A$  is known, the  $U$ -factor and the bypass factor  $Z$  now can be calculated.

**Design-constant and its establishment by test** — While, according to Equations (1) and (2), both  $H$  and  $T$  are parameters of the condenser load  $Q$ , the term

$$K \equiv H/T = (UA)/[(1 - Z)G] \text{ Btu/lb F} \quad (13)$$

is a characteristic design-constant of an evaporative condenser, independent of its load  $Q$ . According to its definition,  $K$  is the effective enthalpy gain of the air per degree "surtemperature." It also can be interpreted as the specific heat gain of unit weight of effective moist air per degree surtemperature.

When substituting  $\epsilon H$  in Equation (11) by  $\epsilon KT$ , as defined by Equation (13), the following equation is obtained:

tion is obtained:

$$T + (\theta_c^2 - \theta_{1w}^2)/T - 2\theta_c = \epsilon K \quad (14)$$

Substitution of  $T$  by  $Q/(UA)$ , as defined by Equation (2), yields the invariant

$$Q + [(UA)^2/Q] (\theta_c^2 - \theta_{1w}^2) - 2\theta_c (UA) = \epsilon K (UA) \quad (15)$$

This equation can be used for the purpose of establishing all relevant quantities by the following test procedure.

When testing a condenser under two sets of different, arbitrary conditions  $Q_1, t_{c1}, (t_{1w})_1$  and  $Q_2, t_{c2}, (t_{1w})_2$ , whereby measuring  $G$  and keeping it constant, Equation (15) yields

$$(UA) = (1/\beta) (\Delta_c - \sqrt{\Delta_c^2 - \beta \Delta_c}), \quad \text{where} \quad (16)$$

$$\beta = [\theta_{c2}^2 - (\theta_{1w})_2^2]/Q_2 - [\theta_{c1}^2 - (\theta_{1w})_1^2]/Q_1$$

$$\Delta_c = \theta_{c2} - \theta_{c1}$$

$$\Delta_c = Q_2 - Q_1$$

As  $U$  thus can be resolved from Equation (16),  $K$  now can be calculated from Equation (15). As  $G$  has been measured,  $Z$  follows finally from  $(1 - Z) = (UA)/(GK)$ .

**Condenser performance and characteristic** — As apart from having served as a basis of design, all parameters and the design-constant of an evaporative condenser can be checked also by test, its performance under varying conditions of operation can be forecast with the aid of Equation (14). It leads to the characteristic performance equation of evaporative condensers:

$$T = Q/(UA) = (\theta_c + \frac{1}{2} \epsilon K) - \sqrt{\epsilon K \theta_c + (\frac{1}{2} \epsilon K)^2 + \theta_{1w}^2} \quad (17)$$

With the numerical values valid for standard atmospheric pressure of 29.92 in. Hg and for a design-constant  $K = 1.0$ , this equation reads

$$T = Q/(UA) = (\theta_c + 42.105) - \sqrt{84.21 \theta_c + 1772.8 + \theta_{1w}^2} \quad (17a)$$

The result of this equation is plotted in Fig. 1 for condensing temperatures  $t_c$  between 75 and 120 F and for wet-bulb temperatures  $t_{1w}$  of the entering air between 60 and 110 F. Similar curves are shown on the diagram for design-constants  $K = 0.9$  and 1.1 Btu/lb F. With the latter values of  $K$ , the product  $(\epsilon K)$  in Equation

(17) takes the numerical values 75.79 and 92.63.

It is obvious that, for the same values of  $t_c$  and  $t_{1w}$ , only the parameter  $T$  will change, if the product ( $\epsilon K$ ) is changed. However, the following will have to be remembered. If an evaporative condenser with a design-constant  $K = 1.0$  is operated at an altitude of 3,450 ft, where the barometric pressure drops to 26.47 in. Hg and  $\epsilon$  changes consequently from 84.21 to 75.79, the performance of that condenser will follow the same characteristic curve as that valid for a condenser of  $K = 0.9$  installed at sea-level. If the design-constant  $K = (UA)/[(1-Z)G]$  is modified, this modification can be brought about by either changing  $(1-Z)G$ , or by changing  $(UA)$ , or by changing both.

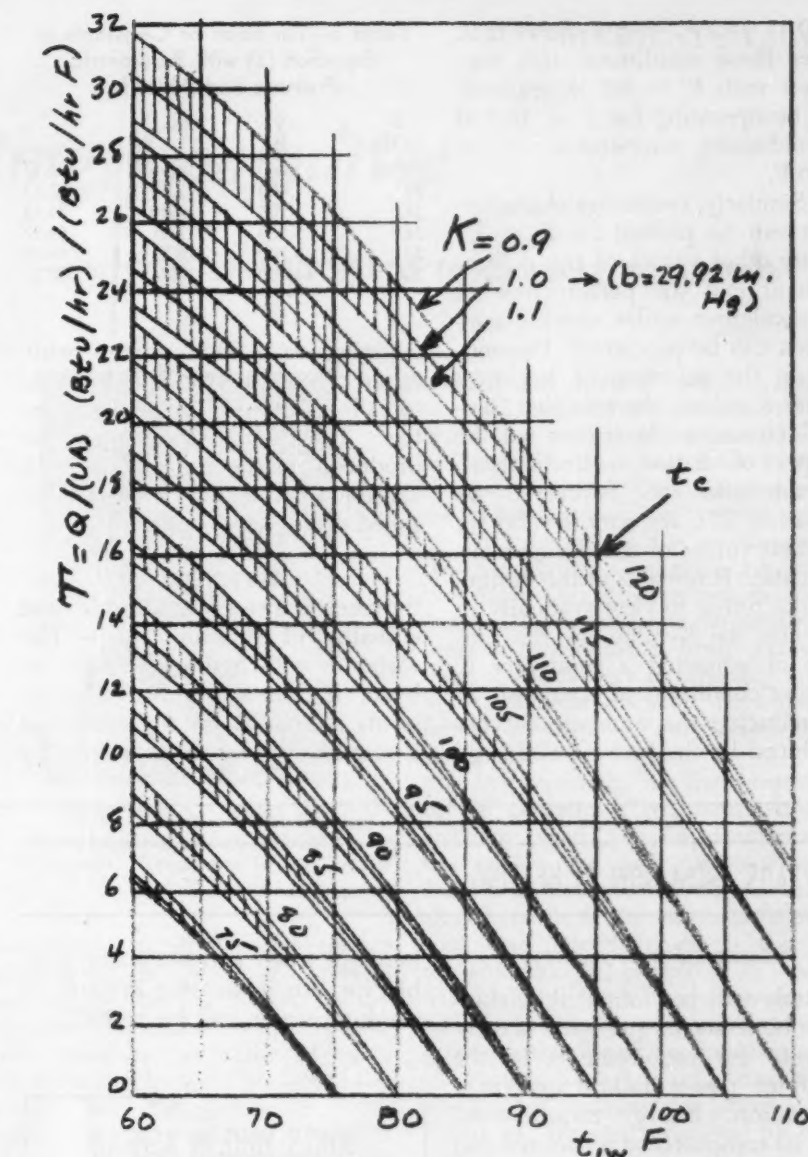
If  $(UA)$  remains constant, then  $T = Q/(UA)$ , as read from the diagram, remains unchanged. If, in turn,  $(UA)$  is changed by a change of  $U$  or  $A$ , then the parameter  $T = Q/(UA)$  represents a different fraction of the condenser load.

#### EXAMPLES AND CONCLUSIONS

With reference to Fig. 1, various operating conditions of an evaporative condenser shall be discussed by way of example. The condenser load  $Q$  is a multiple of the parameter  $T$ ; thus, for instance, for a condenser with  $UA = 4,000$  Btu/hr F, the ordinates  $T$  represent a heat load  $Q = 4,000 T$  Btu/hr.

For a condenser with design-constant  $K = 1.0$  operating at sea-level (29.92 in. Hg) with a condensing temperature  $t_c = 105$  F at ambient wet-bulb temperature  $t_{1w} = 80$  F, the diagram shows  $T = 14.1$ . Consequently, the condenser handles  $Q = 14.1 \times 4,000 = 56,400$  Btu/hr. If  $t_{1w}$  rises by 12 to 92 F, the same heat load, corresponding to constant parameter  $T = 14.1$ , will cause a rise of the condensing temperature by 10 to  $t_c = 115$  F. If  $t_{1w}$  drops by 13 to 67 F,  $t_c$  will drop by 10 to  $t_c = 95$  F. At  $t_c = 115$  F and  $t_{1w} = 80$  F, the same condenser operates on  $T = 20.0$ , thus handling  $Q = 20 \times 4,000 = 80,000$  Btu/hr. The same parameter leads to  $t_c = 120$  F, if  $t_{1w}$  rises to 86, and to  $t_c = 110$  F, if  $t_{1w}$  drops to 73 F.

If now the design-constant is



Variation of parameter  $T = Q/(UA)$  with wet-bulb temperature  $t_{1w}$  of the air at constant condensing temperatures  $t_c$  and for various design-constants  $K = (UA)/(1-Z)G$ , based on 29.92 in. Hg barometric pressure

reduced to  $K = 0.9$ , by means of increasing the effective air quantity  $(1-Z)G$ , this will lead to  $T = 14.6$  at  $t_{1w} = 80$  and  $t_c = 105$  F, thus increasing the capacity of the condenser to  $Q = 14.6 \times 4,000 = 58,400$  Btu/hr. If, at  $t_{1w} = 80$  F, the condenser is required to handle only its original design load  $Q = 14.1 \times 4,000 = 56,400$  Btu/hr, then its condensing temperature will drop to 104.3 F.

The same conditions will occur, if a condenser with design-constant  $K = 1.0$  is installed at an altitude of 3,450 ft, where the normal barometric pressure is 26.47 in. Hg. This behavior finds its explanation by the fact that the nu-

merical value of the product ( $\epsilon K$ ) =  $84.21 \times 0.9 = 75.79 \times 1.0$  remains unchanged in spite of  $\epsilon$  changing with the barometric pressure and thus with the altitude.

If, however, at 29.92 in. Hg ( $\epsilon = 84.21$ ), the design-constant of the condenser under consideration is reduced from 1.0 to 0.9 by reducing  $(UA)$  by 10%, then the specific capacity is reduced to  $0.9 \times 4,000 = 3,600$  Btu/hr F. Consequently, the parameter  $T = 14.1$ , which had been found at  $t_c = 105$  and  $t_{1w} = 80$  F, represents now only the capacity  $Q = 14.1 \times 3,600 = 50,760$  Btu/hr. Hence, the dissipation of 56,400 Btu/hr will now require parameter  $T = 56,400/$



3,600 = 15.7 F. Fig. 1 shows that, under these conditions, this condenser with  $K = 0.9$  at sea-level will be operating for  $T = 15.7$  at a condensing temperature  $t'_c = 106.8$  F.

Similarly, condenser characteristics can be plotted for  $K = 1.1$  or any other values of the design-constant and the performance of the condenser under varying conditions can be predicted. Depending on the selection of lower or higher  $K$ -values, the resulting "natural" characteristic curves will be steeper or flatter. All "natural" characteristics, as expressed by Equation (17), are curves valid for constant values of the design-characteristic. It remains at the designer's discretion to vary gradually or stepwise the  $K$ -value for the purpose of adjusting a condenser to varying conditions of operation, or for reducing the number of types produced by the factory while still

Table I—Variation of Constants in Equation (3) with Barometric Pressure and Altitude

b in. Hg	y ft.	h <sub>o</sub>	ε
29.921	0	16.65	84.21
28	1,800	17.05	79.33
26	3,900	17.48	74.45
24	5,900	17.91	69.57
22	8,200	18.33	64.69
20	10,800	18.76	60.21

covering with each type a wide range of conditions. This leads to so-called "influenced" characteristics. They can, for instance, be produced by the use of fans with variable pitch blades or by variable speed drive.

#### APPENDIX

**Barometric pressure, altitude and enthalpy of saturated air** — The variation with barometric pressure  $b$  in. Hg of the numerical constants  $\epsilon$  and  $h'_o$  in the empirical Equation (3) can be expressed by

the equations

$$\epsilon = 84.21 - 2.44 (29.92 - b) \quad (1.1)$$

$$h'_o = 16.65 + 0.212 (29.92 - b) \quad (1.2)$$

valid for pressures down to 20 in. Hg. Some of the resulting values are compiled in Table I. It also contains the corresponding altitudes  $y$  in ft.

For many applications it is permissible to base the variation of barometric pressure with altitude on a pressure drop of 1 in. Hg per 1,000 ft-level difference up to altitudes of 10,000 ft. In that case, the above equations, referred to altitudes  $y$  measured in ft above sea-level, can be written

$$\epsilon = 84.21 - 2.44 (y/1000) \quad (1.3)$$

$$h'_o = 16.65 + 0.212 (y/1000) \quad (1.4)$$

#### REFERENCES

1. D. D. Wile, "Evaporative Condenser Performance Factors", Refrigerating Engineering, Jan. 1950.
2. ASRE DATA BOOK, Design Volume, 10th Ed., Chapt. 21.
3. ASHRAE GUIDE 1960, Chapt. 3.

## 25 YEARS FROM NOW IN HEATING

(Continued from page 41)

controls will be dominant, including a built-in energy source to compensate for requirements in the event of power failure or power fluctuation. Energy requirements will be computed on a national and area level, making it possible for cooler sections of the country to be supplied with energy from areas experiencing warm trends.

### Service and maintenance of equipment:

Far less will be required per unit of operation simply because the frequency of failure will decrease through better quality control.

Milk-run type operations involving planned preventative maintenance programs will be available for those who wish to participate.

Automatic cleaning devices will reduce the necessity for shut-down periods on boilers and other heating devices.

Through greatly improved water purification, the expensive corrosive conditions in certain sections of the country will be eliminated. Water purification will be of the utmost importance and making

brackish water and sea water potable for use in heating systems or drinking water will be a reality.

### WHO'S WHO IN ASHRAE

Insofar as possible these listings will each appear twice a year

#### ASHRAE OFFICERS, DIRECTORS COMMITTEES, STAFF

See page 80, this issue

#### REGION AND CHAPTER OFFICERS

See page 80, March JOURNAL

#### RESEARCH AND TECHNICAL COMMITTEES

See page 67, September JOURNAL

#### STANDARDS PROJECTS

See page 74, January JOURNAL

#### INTER SOCIETY COMMITTEES

See page 84, November JOURNAL

More remote control plants will operate from central station control panels.

Inspection of surfaces in boilers or heat exchangers will be accomplished by using radioactive tracers as a part of a routine maintenance program.

### Efficiencies:

Today we talk in terms of 80% efficiency in boiler equipment. With more effective means of burning fuels and with higher heat transfer rates possible with new design, efficiencies in excess of 90% will be obtainable readily 25 years from now.

### New concepts:

There will be an entirely new concept relating to heat transfer and the liquids and gases which can best accomplish it. This point could help the oil industry, which is in a position to develop high heat transfer fluids more efficient and effective than present day water, steam or heat transfer oils.

There is no question that some of the points mentioned here are closer to reality than others. Nonetheless, it is felt that the accomplishments in the heating industry within the next 25 years could greatly outnumber those of the past 25 years.



# The Nominating Committee

— why it is important to Society members

President Tull has asked me to use the President's Page to tell you about the Nominating Committee and why it is important to all of our Society members. As Chairman of the Nominating Committee which has just completed its assignments, I am pleased to do so.

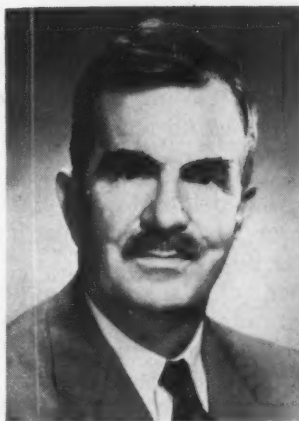
In a very small group, each member can contribute directly to its leadership. In larger and more widespread organizations, the individual member's contribution to leadership is necessarily less direct and may be carried out by proxy or at a local level. At the same time, the need for competent leadership is increased, not only due to the complexity of the problems which must be resolved, but also to the longer lines of communication between the members and the leaders.

Our merged Society has taken on increased responsibilities to see that the more diverse interests of its greater membership are well served. It is self-evident that the vigor and growth of our Society depends in large measure on the quality of its leadership.

In choosing our leaders, we have established the principle that: "The office should seek the man rather than the man seek the office." Choice for office is an honor and a responsibility. The criteria for selection should be proven competence not only in the profession but in executing committee assignments and filling other offices in the Society.

Because the method of selection is not political and because campaigning for office, in the political sense, would be inappropriate, only one nomination is made by the Nominating Committee for each position to be filled. This places an added responsibility on the Nominating Committee to make sure that the slate selected is the best possible. At the same time, the way is left open, under the By-laws, for any group of members to make other nominations if they feel that these would better serve the Society.

In order to provide a Nominating Committee which is both competent and responsive to the



CARLYLE M. ASHLEY  
Presidential Member, ASHRAE  
Chairman, Nominating Committee

membership, six of the members are selected by the Board of Directors and ten by the ten Regions at the Chapters' Regional Meetings. To provide continuity, an additional member is selected by the President of the Society from the preceding Nominating Committee and the Chairman is the most recent President of the Society who has completed his service on the Board of Directors. Alternates are selected for each committee member.

In order to select able members for the Committee, the President appoints a committee from the Board to make recommendations which are then considered and acted upon by the whole Board. The six committee members chosen by the Board must also represent the major areas of interest of the Society membership, that is, two each to represent heating, refrigerating and air conditioning.

At each Chapters' Regional Meeting, the delegates representing each of the chapters within the region select a member and an alternate to the Nominating Committee. It is natural that there should be a desire to pass the honor of committee membership around among the various chapters of a region over a period of years. This is not only permissible, but desirable, provided the chapter representatives preserve their freedom to choose the best committee

member and alternate possible, rather than turning this choice over to a previously designated chapter. Recommendations have been made to the Regions Central Committee of a mechanism for carrying this out.

It is important that members of the Nominating Committee be mature, able and disinterested people. But equally important is the need for members who have a broad knowledge of the Society membership and how individual members have performed in their various Society assignments.

In preparation for the meetings of the Committee, recommendations are encouraged from the members of the Society. For each person whose name is recommended, a biographical record is sent to the members of the committee. The Nominating Committee which has just completed its work has used this list to prepare suggestions for committee assignments to be given to the incoming President of the Society, as well as using it as the selection of nominees for officer and Board of Director positions to be filled.

The Committee meets twice during the year, the first time to organize, agree upon procedure and give preliminary consideration to names suggested for the positions to be filled. At the second meeting, the actual nominations are made. A subcommittee of the last Nominating Committee prepared an Operational Guide which should help to simplify the work of future committees.

It may seem surprising, but the list of Members who can be given serious consideration for nomination as an officer of the Society is quite short. An important reason for this is that besides high professional and personal qualifications, service and experience on committees and on the Board are highly desirable. Some otherwise acceptable Members are not able to give the necessary time required for officership of the Society, while other Members may not appear ready for present consideration. The training and selection of its leaders is a difficult problem for the Society.

(Continued on page 88)

Small water quantities and small size pipes  
can provide

# More Economical MTW Systems

Over several years, the author has gathered data upon the use of deep system temperature drops and primary-secondary pumping in the design of low temperature hot water heating systems. For the most part, the design objective has been the comfort of occupants of buildings. Some process work has been involved, such as sterilization and distillation, and also such services as snow melting, potable water heating and cooking. This experience has included the actual task of directing the process of putting the systems into good heat distribution balance and capability of design operating demonstrations.

The objective here is to establish some facts and present findings for an economic comparison of the following systems:

1. A system of low temperature forced circulation hot water heating using a primary pumping arrangement; the generally accepted 20 deg to sometimes as much as 50 deg system temperature drop and the capacity to deliver for use as much as 25,000 Btu/hr per gpm of water flow.

2. A system of low temperature forced circulation hot water heating using a primary-secondary pumping arrangement; a system temperature drop that reaches 130 deg and is able to deliver for use 65,000 Btu/hr per gpm of water flow.

3. A system of medium temperature forced circulation hot water heating using a primary-secondary pumping arrangement; a

system temperature drop that reaches, and sometimes exceeds, 200 deg can deliver for use 100,000 Btu/hr or slightly more per gpm of water flow.

Each of the above systems uses standard equipment and schedule 40 piping which is produced in an extensive variety of types and kinds in mass quantities at favorable cost.

## NEW IDEAS SOUGHT

Hydronics engineers have long searched for a means of transporting economically a large quantity of heat over considerable distance, then delivering it under good control for use. The knowledge of the simple fact that large quantities of heat always have been transported in the water stream of the main piping of the conventional low temperature hot water heating system seems to have escaped notice by most of the engineers for many years. This is evidenced by the terminal equipment of nearly every manufacturer, which is rated capacity-wise by velocity of flow through the exchange media, that

compels a volume of flow in the system resulting in a shallow system temperature drop. The design concept of a system of primary pumping to supply the volume of flow required by this category of terminal equipment usually results in massive piping, high vagrant heat loss, large valves, difficult control, almost excessive hp pumps and disappointing operating costs.

There are fundamental reasons why the so-called conventional hot water system when applied to projects of some consequence continues to fail to perform in an impressive way; however, space does not permit a detailed discussion of these reasons for failure.

In Fig. 1, a conventional (LTW) system, using primary pumping, is shown in brief outline. Reasons why this concept of design has failed and continues to fail to produce results that will gain acceptance of engineers in the Hydronics industry follow.

## CONVENTIONAL (LTW) DESIGN AND TROUBLE SOURCES

Conventional systems of low tem-

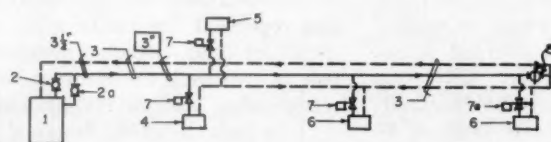


Figure 1

- 1 Source of heat
- 2 System heat pump 3 H.P.  $\frac{1}{2}$  H.P.
- 2a System heat pump standby 3 H.P.  $\frac{1}{2}$  H.P.
- 3 Reverse return system HWS and HWR mains
- 4 180° potable water heater
- 5 140° potable water heater
- 6 Terminal equipment
- 7 Auto control valve shut off
- 7a Auto control valve diverting
- 8 Pressure relief valve
- 3 1/2 Sizes 20° drop
- 2 Sizes 65° drop

Note  
A 65° TA system with pipe  
and pump sizes identified  
requires 58 gpm. HWS

Fig. 1 School-direct  
pumping. 20 deg tem-  
perature drop; 1,280,-  
000 Btu/hr load; 128  
gpm HWS

Homer M. Bird is with Bird, Bird and Associates, Consulting Engineers. This paper was presented at the Medium Temperature Water Heating Symposium at the ASHRAE Semi-annual Meeting in Chicago, Ill., February 13-16, 1961.



perature hot water heating, require circulation of comparatively large quantities of water with a primary pumping arrangement, working at a relatively high head, using volume shut off and sometimes diverting (three-way) motorized valves for control and a 20 deg system temperature drop. This becomes extremely wasteful as compared with an alternate design. The LTW system temperature of 200 to 220 deg leaves a wide margin for error in design and application at the expense of first cost as well as operating cost.

Use of volume shut off valves for temperature control, both the modulating and two position types, has led to many problems that are as yet unsolved. When a number of valves along a main system operate in rapidly varying pattern, any individual valve will position at one time or another with the maximum possible system pressure drop across its port. An instant later it may encounter the minimum of drop due to action of other valves long before it could possibly have been instructed and responded to re-position.

While this rapidly fluctuating pressure drop condition makes movement of the valve to a directed position almost impossible, the amount of heat for use in the terminal equipment compared to actual requirements likewise is fluctuating just as rapidly, but almost always, if not always, exceeding the real demand. Various means of solving this problem of heat volume varying from demand by so wide a margin, such as a pressure relief by-pass at the pumps or along the main system, have met with but modest success.

Use of three-way valves in a diverting position forcing varying proportions of water through the heating element, while the remainder always passes directly from the supply main to the return main, does to a marked extent reduce the fluctuations of pressure under which the valve must perform. At the same time, it introduces undesirable side effects such as by-passing within terminal equipment elements and resulting uneven heat stream, freeze-up hazard, unreliable air purge and excessive fouling factor. With this valving arrangement, the pressure

drops across the valve port and thus the volume of flow through any specific piece of terminal equipment does fluctuate, but with some to much less difference than with shut off valves; because the only force causing the fluctuations is the difference in the resistance through the element and the diverting by-pass.

Use of properly sized resistance orifices in the by-pass is a half way solution to this problem, but it can be relatively expensive considering the need for careful engineering, strainers in each by-pass and extra fitting care. The three-way diverting valve is in itself relatively expensive and it becomes hard to reach with the average budget when the cost of extra fitting and an orifice are added. On Schedule 5, line 1, are comparison figures of interest.

#### PRIMARY (LTW) PUMPING AND DEEP TEMPERATURE DROPS

Resort to deep temperature drops of 40 to 80 deg in systems using readily available standard equipment and primary pumping arrangements does reduce piping system, pumping and related initial and also operating costs. It would seem that this maneuver is justified for this foregoing reason; however, although an improvement over conventional shallow temperature drop systems, this reason alone is not sufficient to form the basis for a new design concept. The drawback to using a deep temperature drop in this type of system is that it actually multiplies and intensifies the problems of a conventional 20 deg drop system that have been pointed out previously. Small water quantities flowing through the heat ex-



HOMER M. BIRD

changers of terminal equipment made for large water quantities result in by-passing and consequent uneven heat streaks, freeze-ups, lack of air purge ability, fast fouling factor build up due to more rapid particle fallout and unreliable control.

Use of terminal equipment built for deep temperature drops modifies the remarks just made to a marked extent. This equipment with its small water quantity demands, well defined waterways and resulting lower pump heads, makes control more certain, practically eliminates fouling and freeze-ups and maintains good air purge.

Comparison figures for a system with this equipment for the example school under discussion are presented on line two of Schedule 5.

It should be remembered when considering the validity of these remarks that valves are available in but few sizes, design pressure drop across a valve port from a primary pump without secondary by-passes is singular only at design conditions which seldom, if ever, occur and the real gpm require-

Engineers active in the field of hydronics have been searching for ways to move large quantities of heat over great distances, economically and under good control for use . . .

Medium temperature, forced circulation, hot water heating with primary-secondary pumping and terminal equipment calls for small water quantities or deep temperature drops . . .

Should 325 deg (MTW) system be objective of engineers?

But a new approach to pumping is necessary by pump manufacturers . . .



1	2	3	4	5	6	7	8	9	10	11	12	13
LINE	KIND OF SYSTEM	FIG. NO	MbH LOAD	SIZE SOURCE HEAT CIRCUIT	SIZE PRIMARY MAINS LARGE END	GPM-SOURCE CIRCULATION	GPM SOURCE HEAT CIRCUIT	GPM PRIMARY HEAT CIRCUIT	Ft. Lbs. WORK INDEX	CONNECTED PUMP H.P.	RUNNING PUMP H.P.	PUMP KWH
1	LTW-PP 20°TD-220°SHS	1	1250	NONE	3 1/2"	NONE	NONE	125.00	1.00	5.33	3.33	3.30
2	LTW-PP 65°TD-DEEP DROP TERMINAL EQUIP.	1	1250	NONE	3"	NONE	NONE	55.00	.33	1.83	1.83	2.00
3	LTW-PS 130°TD-247°SHS	3	1250	1 1/2"	2"	NONE	15.4	16.25	.087	1.95	.84	1.76
4	MTW-PS 150°TD-275°SHS	3	1250	1 1/2" / 1 1/4"	1 1/2"	NONE	13.3	14.10	.065	1.95	.84	1.76
5	MTW-PS 205°TD-325°SHS	4	1250	1 1/4"	1 1/2"	16 (1)	9.85	10.50	.067	1.43	.56	1.28

1	14	15	16	17	18	19	20	21
LINE	SEASON PUMP ENERGY COST (5)	COST INDEX PIPING SYSTEM	COST INDEX CONTROL SYSTEM	SYSTEM INITIAL COST	INITIAL SAVING	20YR FINANCE SAVING 5%	40YR OPERATING SAVING ELEC. ENERGY ONLY	40YR. LIFE TIME SAVING (4)
1	396.00	1.00	1.00	52000.00				
2	240.00	.915	1.00	51000.00	1000.00 (3)	500.00	6240.00	21000.00
3	215.00	.75	.60	46300.00	5700.00	2850.00	7440.00	52000.00
4	200.00	.72	.67	46600.00 (3)	5400.00	2700.00	7840.00	51500.00
5	172.00	.70	.75	46300.00 (3)	5800.00	2900.00	9040.00	56400.00

- 16 GPM. IS THIS BUILDING'S SHARE OF 69 GPM. ASSUMED NECESSARY FOR WHOLE LOAD.
- NO ADJUSTMENT FOR POSSIBLE ADDITIONAL COST OF TERMINAL EQUIPMENT FOR DEEP TEMPERATURE DROP.
- ADDITIONAL COST OF 100# BOILER PUMPS & DEEP DROP TERMINAL EQUIPMENT CONSIDERED.
- THESE AMOUNTS INCLUDE ONLY THE BASIC FIGURES FROM COLUMNS 18, 19 & 20 WITH THE FINANCE SAVINGS OF THE 40 YEAR LIFE TIME ADDED
- 5.02 PER KWH USED AS COST OF ELECTRIC ENERGY;  
SHS = SOURCE HEAT SUPPLY      PP = PRIMARY PUMPING  
TD = TEMPERATURE DROP      PS = PRIMARY SECONDARY PUMPING

Schedule 5 — Comparison figures for five systems

ments for the numerous pieces of terminal equipment on a project are equally numerous. This is an impossible set of conditions to be translated into good design. It follows that the ideal conditions for translation into good design are a concept: where the pressure drop and flow across all control points is constant, where the water quantities are small, and where the rate of flow through the terminal equipment is constant and can be set permanently to exactly the volume required.

#### NEW DESIGN CONCEPT

There is now on the industry horizon a prospect of a design concept that will fulfill the search for an economical way to transport large quantity of heat over great distances with a means of delivering it under good control for use. This design concept is medium tem-

perature forced circulation hot water heating using primary-secondary pumping and terminal equipment designed for small water quantities (or deep temperature drops).

This system, due to the exceptionally small water quantities required, utilizes extremely small size mains, branches, pumps and valves. Such small size pipe is comparatively light in weight and thus places but little load on the supporting structure; further, it is flexible, easy to hang, and has provisions for movement due to expansion and contraction which are quite simple.

Since required pipe sizes are small, the designer can afford to be generous in sizing the piping system and thus keep resistance low and, likewise, the pump heads. In fact, pumping heads for systems of considerable consequence are

often under the five to seven psi considered as the minimum necessary by most designers for drop across a control valve port. Water flow is always constant and pressures do not vary.

Also, due to the small pipe sizes used, vagrant heat loss is held to a minimum. Heat loss from a pipe varies in about direct proportion to circumference, thus a 3 1/2-in. line loses 2.35 times that of a 1 1/2-in. line of equal length. Further, the cost of the small pipe system permits use of more effective insulation and still keeps cost within good limits.

Temperature control can be, and frequently is, accomplished without the use of motorized valves. Mixing water to obtain temperatures other than source temperature for as many purposes as may be needed is achieved by pumping source heating water supply in

controlled quantity into another pumped circuit, and taking from the latter an equal quantity of its return water for return to the source circuit. Commonly known zone control is effected simply by a thermostat cycling a zone pump that circulates heating water through the zone terminal equipment. Motorized valves often can be used for zone control, mixing and other functions as the designer may choose. When they are used, in nearly all cases they can be arranged so the pressure drop and flow across the port will be constant.

#### PRIMARY-SECONDARY PUMPING DESIGN CONCEPT (LTW)

Primary-secondary pumping permits a design concept using low temperature forced circulation hot water heating, using available standard equipment, with a system temperature drop of 60 deg always expected and often in excess of 100 deg, is possible with some installations with 130 deg drops in use.

This system of pumping may need some explanation; an outline of a simple system shown in Fig. 2.

The system source of heat, (1) may be a boiler, a convector or a heat storage container, any one of which could be one of several types. The temperature at the supply tap of the source of heat should be kept constant just under 250 deg.

The source heat circuit (2) serves only to supply heat to the primary mixing tank (4) perhaps close to the source of heat (1). A source heat circuit may extend through a large building to several wings or throughout a school campus or to several buildings of a commercial or industrial complex of buildings. Wherever desired along its length, heat supply for several mixing tanks and other purposes, such as heating potable water, may be taken off. This option is illustrated in Fig. 3. The source heat circuit pump (3) runs only at the demand of a weather adjusted controller located in the primary heat circuit (5) shortly after the discharge of the primary pump (6) to maintain an adjusted temperature in the primary circuit.

In more complex systems the source heat circuit pump may be cycled by several controllers or it

may be started by a master controller when the outdoor temperature drops to a degree that demands heat in the building. Pumps assisting during periods of near design condition arranged in series and often in parallel, acting also as emergency stand-bys, are used with many sequencing control schemes possible and adaptable.

The primary mixing tank (4) is a properly sized compartment wherein source heating water is mixed with return primary heating water to deliver supply primary heating water to the primary heat circuit (5) at a temperature sufficient to satisfy the system demand for heat. During this process of mixing, a quantity of return primary heating water equal to the supply of source heating water is returned to the source heating water return, thus keeping the circuits in balance with regard to pressure and volume.

The primary heat circuit (5) serves to transport primary heating supply water continuously in a constant volume to zone primary by-passes (7) spaced at required intervals, dictated by zone locations, throughout the length of the mains.

The primary pump (6) circulates primary heating water through the primary heat circuit (5), the primary mixing tank (4), and the zone primary by-passes (7) continuously at a constant volume whenever there is a demand for heat. This pump usually is cycled by a master controller to start when outdoor temperatures drop to a degree that demands heat in the building. Here, like the source heat circuit pumps, series and parallel arrangements are used often to assist each other and act as an emergency stand-by with a whole group of sequencing control methods possible and adaptable.

The zone primary water by-pass (7) simply connects the primary heating water supply to the primary heating water return to allow water to flow from one to the other to complete the primary heat circuit. Water flow through the by-pass is constant and continuous without any measurable pressure change, regardless of the amount of water being pumped out of and into any one or any number of connected by-passes. It

is to be noted that the by-pass consists of three parts or sections of piping: the supply section (7A), the common section (7B), and the return section (7C).

Primary heating water flows directly through the three sections of the by-pass when the zone pump (9) is idle—when this pump is running, the primary heating water supply from supply section (7A) is forced into the zone heat circuit (8) heating water supply main mixed with a selected quantity of zone heating water return flowing up stream of the primary flow in the common section (7B). There is then flowing in the return section (7C) to the primary heating water return main a quantity of water equal to that flowing in section (7A).

The zone heat circuit (8) consists of a heating water supply and a heating water return to and from the zone terminal equipment (10). There are many variations of arrangement of the zone heat circuit; it often has connections to several or many pieces of terminal equipment.

The zone pump (9) circulates zone heat circuit heating water through the terminal equipment of the specific zone. This pump, if there is but one or several pieces of terminal equipment making up the zone under the control of one thermostat, runs only at the demand for heat from the thermostat.

The individual piece of terminal equipment (10) may be any type of a gravity convector, any type of a radiant convector, any type of a forced flow convector, or any type converter.

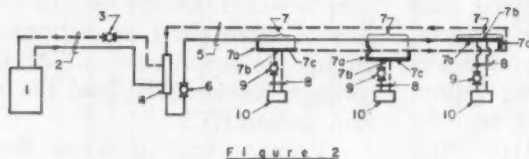
#### PRIMARY-SECONDARY PUMPING AND 130 DEG TEMPERATURE DROP (LTW)

An example of primary-secondary pumping applied to a low temperature hot water heating system follows (Fig. 3). Supporting figures for comparison are summarized in Schedule 5, line 3. The load and other calculations are for an actual working installation.

The same identification numbers used in describing primary-secondary pumping for Fig. 2 are used again for Fig. 3.

The source of heat (1) is a boiler plant with a capacity of 5,400,000 Btu/hr. It is located at





- Figure 2
- 1 Source of heat
  - 2 Source heat circuit
  - 3 Source heat pump
  - 4 Primary mixing tank
  - 5 Primary heat circuit
  - 6 Primary heat pump
  - 7 Zone primary by pass
  - 7a Zone primary by pass supply section
  - 7b Zone primary by pass common section
  - 7c Zone primary by pass return section
  - 8 Zone heat circuit
  - 9 Zone heat pump
  - 10 Terminal equipment

Fig. 2 Simple primary-secondary pumping diagram

or near the center of the institution campus some distance from the elementary grade school building to be considered in this discussion. This building has a heating and ventilating load demand at design conditions of 1,000,000 Btu/hr. There is also a potable water heating demand for 4 gpm heated through a temperature rise of 40 to 180 deg that requires 280,000 Btu/hr.

The source heat circuit (2) is designed to transport the total 1,280,000 Btu/hr to the building from the boilers in the vehicle of normally 15.4 gpm through a system temperature drop of 130 deg in a 1½-in. pipe line with a developed equivalent length of 550 in. and a resistance head of 11 ft.

Item 14 represents source heat circuit to other buildings and accounts for the balance of the load on the source of heat (1) listed previously as 5,400,000 Btu/hr.

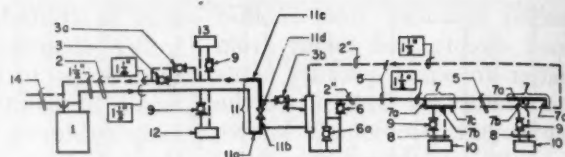
The source heat circuit pump (3) is a 1½-in., 1/6-hp on the line type. A second pump of the same description (3A), in series or acting alone, is introduced here to standby (3) in the event of breakdown and to assist (3) in handling the load whenever it approaches or exceeds design conditions. The index for assist is when the source heat circuit (2) return water temperature drops below a temperature that will convert to the potable hot water stream less than 140 deg. This does not occur frequently, perhaps not more than an accumulated three percent of the time. Observation would probably reveal that a heating system in this type of a building seldom, if ever, operates at the design

load. There is also another function for this pump (3A) to act to increase the gpm in the circuit to about 21 gpm for quick heat up of the building whenever scheduled or whenever desired.

It is to be noted that when this circuit has load connections spaced at intervals throughout its entire length the return should be reversed to implement a balanced flow.

The primary mixing tank (4) located at the end of the source heat circuit is a piece of 4-in. pipe 24 in. long. The mixing pump (3B) is a 1/12-hp unit that moves as much as 21 gpm against about a 1 ft 6 in. head from the source heat circuit by-pass (11) to the mixing tank. This pump runs just enough to deliver the heat demanded to meet the load on the primary circuit, which averages about 50 percent of the time through a heating season.

Attention is directed to the connections for heat supply to the 180-deg potable water heater (12) preceding (11A) and the one for the 140-deg potable water heater (13) following (11C), by this arrangement no work to supply this 280,000 Btu/hr heat load for potable water heating is added to that required of pumps (3) and (3A), to handle the 15.4 gpm needed for the 1,000,000 Btu/hr for heating and ventilating. The zone pumps (9) run to supply heat to the water heaters as needed, they are sched-



- Figure 3
- 1 Source of heat
  - 2 Source heat circuit
  - 3 Source heat pump 1/6 HP
  - 3A Source heat standby or assist pump 1/6 HP
  - 4 Primary mixing tank
  - 5 Primary heat circuit
  - 6 Primary heat pump 1/6 HP
  - 7 Zone primary by pass
  - 7a Zone primary by pass supply section
  - 7b Zone primary by pass common section
  - 7c Zone primary by pass return section
  - 8 Zone heat circuit
  - 9 Zone heat pump all 1/25 HP
  - 10 Terminal equipment
  - 11 Source heat by pass
  - 11a Source heat by pass supply section
  - 11b Source heat by pass common section
  - 11c Source heat by pass return section
  - 11d Emergency circulation valve
  - 12 180° potable water heater
  - 13 140° potable water heater
  - 14 Source heat circuit to other buildings (4)
- Note: A 150° to MTW system with a 275° source with pipe and pump sizes identified requires:  
 13.8 Gpm SHW - 150° Td.  
 14.10 Gpm PHW - 140° Td.

Fig. 3 School-primary-secondary pumping. 130 deg temperature drop; 1,280,000 Btu/hr load; 15.4 gpm SHW, 130 deg Td; 16.2 gpm PHW, 123 deg Td

uled to operate only when the building is occupied, subject to manual override for use of janitors or special occasions.

The primary circuit (5) is designed to transport 1,000,000 Btu/hr to the terminal equipment units (10), from the mixing tank (4) in the vehicle of 16.25 gpm through a circuit temperature drop of 123 deg. The circuit starts 2 in. in size and reduces at certain by-passes. It has a developed equivalent length of 1000 ft and a resistance head of 10 ft 6 in. The load, made up of 28 zones and 36 pieces of terminal equipment (10), is actually stretched over the whole length of the circuit in the building; however, to shorten the discussion, it is shown here connected at two points only. The return is entirely reversed to gain an almost balanced flow without the use of balance valve adjustment.

There are two primary pumps (6) and (6A) each 1/6 hp on the line type. The second pump (6A) in series or acting alone stands by pump (6) in the event of breakdown or to assist pump (6) when quick heat up is scheduled or manually selected. This pump (6) runs whenever there is a demand for heat indexed by outdoor temperature.

Zone primary by-passes (7) occur at each zone station location. They are sized ½ in. (7A), ¾ in. (7B), and ½ in. (7C), except 7B is sometimes ½ in.



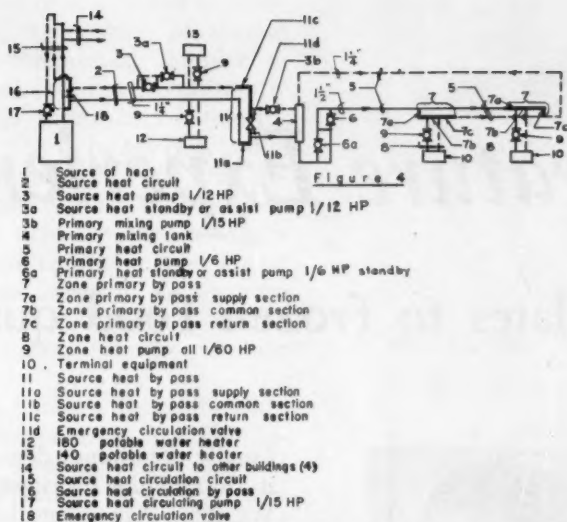


Fig. 4 Hypothetical proposition. School-primary-secondary pumping. 203 deg system temperature drop; 1,280,000 Btu/hr load; 9.85 gpm SHW, 203 deg Td; 10.50 gpm PHW, 190 deg Td

In this system the zone heat circuits (8) are sized  $\frac{1}{2}$  in. for the most part with some  $\frac{3}{4}$  in. lines. These circuits are quite short, seldom over 50 ft.

The zone pumps, (9) all 1/25 hp, run only to satisfy the heat demand from the zone thermostat; there are 28 of these pumps. Recording instruments show that in severe weather, in a building such as this example school, these pumps run about 50 per cent of the time, tapering off to no running time when there is no demand for heat. It seems safe to say that the pumps through a full heating season run one-third of the time. These pumps keep the flow through the heat exchange elements relatively high, actually on the average of 4 fps—thus, the emissivity rate is optimum.

Among the terminal equipment units (10) there are 16 unit ventilators, five forced flow convectors and 15 gravity convectors. The temperature drops through the zone primary by-passes at design conditions are 130, 100 and 40 deg, respectively, for unit ventilators, forced flow convectors and gravity convectors. Actually, the drops through the terminal equipment heat exchange elements are much less, being 15 deg for unit ventilators, 10 deg for forced flow convectors and as low as 5 deg in some of the gravity convectors.

Source heat by-pass (11), like

the zone primary by-pass (7), simply connects the source heating water supply to the source heating water return to complete the source heat circuit. The sections 11a, 11b and 11c function the same as 7a, 7b and 7c, described in the run-down on Fig. 2.

There is introduced here a new item (11d) emergency circulation valve. This valve, when closed with pump 3b idle, will force the output of pumps 3 and 3a to flow through the mixing tank (4). Frequently, when such a valve is placed in the common section (7b) of a zone primary by-pass (7), when closed it will act to cause a limited emergency flow in the connected zone heat circuit (8).

Schedule 5 on line 3 lists comparison figures. Line 4 of this schedule gives comparison figures for a (MTW) system with a 275 deg source of heat; a 150 deg system temperature drop and deep drop terminal equipment. The outline for this 150 deg drop system is illustrated in Fig. 3, as the system components are identical with regard to identification and function.

#### PRIMARY-SECONDARY PUMPING AND 203 DEG TEMPERATURE DROP (MTW)

A primary-secondary pumping arrangement applied to a (MTW) medium temperature hot water heating system is illustrated in Fig.

4. This is for the same school building discussed previously and illustrated by Fig. 3.

The same identification numbers used on Figs. 2 and 3 are again found here. There are the following additional items needing explanation.

The source heat circulation circuit (15) with (17) the source heat circulation pump serves to circulate the required amount of water at the required temperature through the waterways of the system source of heat (1).

A source heat circulation by-pass (16) serves the same purpose here as does (11) in the source heat circuit (2) and the zone primary by-pass (7) in the primary heat circuit (5).

An emergency circulation valve (18) has a similar function as (11d) in the source heat by-pass (11).

This system is based on a 203 deg system temperature drop. The "Hypothetical Proposition" label on Fig. 4 refers only to the author's opinion that the pumps (3, 3a, 3b, and 17) selected are not available and, further, that if available pumps were used in the comparison figures the (MTW) system would be in an unfavorable position, operation cost-wise, compared to the systems discussed on Fig. 3. As this Fig. 4 system becomes larger as to water quantities and distance, it ceases to be hypothetical because pumps are available when hp requirements rise above  $\frac{1}{4}$  hp. Schedule 5 on line 5 lists comparison figures.

#### SUMMARY

These figures and indexes used in Schedule 5 were gathered and put together by the author. The sources were considered reliable and the best available.

It seems evident from the Schedule 5 comparison that the 325 deg (MTW) system illustrated on Fig. 4 is a worthy objective for hydronics engineers. To achieve this goal requires a new approach to pumping by the pump manufacturers. Small flea power motors insulated for 325 deg for pumps of small dimensions and even smaller capacities in the range of 1 to 4 gpm at extremely low heads are a must. Also, the manufacturers of

(Continued on page 88)

Integrated

# Time-Temperature Experience

as it relates to frozen food quality

Frozen foods, recognized for their superior quality over many years, have gained the acceptance of increasing numbers of people and undoubtedly will continue to do so in the future. This superior quality, however, is not insured automatically by the mere act of freezing and storing the product at a low temperature. Many, many factors other than time-temperature experience in the distribution system must be controlled carefully in order to attain the excellence that we expect from frozen foods. These include such things as growing conditions, harvesting practices, handling after harvesting and probably most important of all, processing and freezing variables.

In most cases, the ultimate quality is determined largely by the care and control which is exercised over all of these factors. If each has been controlled carefully, the initially frozen product will have excellent quality, but should one or more of these factors have been neglected, quality will be something less than the best; no amount of care in the distribution system can restore it.

By this, I do not wish to imply that the temperature of frozen products is unimportant. Obviously, there have been and still are certain instances of flagrant temperature abuse in the distribution system. Transportation and handling of frozen foods at ambient temperatures will cause rapid thawing. It is well known that really serious quality losses can occur with extreme rapidity at thawing temperatures. In general, these con-

D. G. Guadagni is responsible for Food Appraisal Investigations at the Western Regional Research Laboratory, U. S. Department of Agriculture. This paper, here slightly condensed, was presented at the Frozen Food Handling Symposium, ASHRAE Semiannual Meeting in Chicago, February 13-16, 1961.



D. G. GUADAGNI

ditions represent the exception rather than the rule but, unfortunately, exceptional cases always seem to draw the spotlight of at-

usually determines degree of quality loss in the distribution system. We must remember that now we are concerned only with those quality losses which occur after the product initially is frozen to 0 F.

Regardless of the quality level of the product when it enters the distribution system, we can measure the effect of time and temperature by periodically comparing samples held at steady temperatures with controls from the same lot of material held at temperatures low enough to prevent quality changes. When these comparisons are made with trained and selected taste panels utilizing difference tests such as the triangle or duo trio, the time interval re-

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Ultimate quality of a product is determined by the care and control in all phases of its growth, processing, freezing and distribution.

Exceptional care in one link of that chain can never make up for possible weaknesses in the others.

---

tention and form the basis for attacks on any handling operation where temperatures creep above 0 F for even short periods.

While the importance of time as well as temperature should be obvious to anyone who has studied the results of our extensive time-temperature tolerance investigations, it appears that the factor of time has not been appreciated fully. In this discussion, we will attempt to stress the fact that the integrated effect of both time and temperature is the factor which

quired for the panel to detect a real change in color, flavor or texture constitutes the basic measure of quality change or quality loss. We have often referred to this time interval at a given temperature as the high quality life at that temperature.

Obviously, we could refer to this degree of quality change with any number of other appropriate expressions such as time to a detectable quality change, unit of quality change, a degree of deterioration, etc. But the important



point is that over a period of many years and the testing of several thousand commercial samples of frozen food, we have consistently found this measure of quality change or loss to be fairly accurate and reproducible. While this degree of quality loss is almost certainly less than the amount which would cause consumer rejection, it nevertheless serves as an accurate yardstick for measurement of the effects of various time-temperature exposures.

Table I shows the relationship between temperature and the approximate average time required to cause a definite organoleptically measurable change in a number of frozen foods. The time in this table will vary for various products and even within a product there will be variations between lots, but the general exponential relation between temperature and time to produce this given degree of quality change holds for most frozen products studied. For every 5 F that the temperature is increased, the rate or speed of quality loss increases from about 2 to 2½ fold.

It must be emphasized, however, that the quality change brought about by each of these time-temperature combinations is essentially the same. Therefore, if we start the experiment with the same quality level, the sample held at 25 F for 1 week will be the same or indistinguishable from the sample held at 0 F for one year or from the samples held at any of the other time-temperature combinations listed in Table I. From these data, it is clear that a week at 20 F is certainly no worse than 6 months at 0 F. As a matter of fact, on the average, neither of these time-temperature combinations alone would cause a noticeable quality change, but the two experiences combined would have the same effect as 1 year at 0 or 2 weeks at 20 F.

This table presents a simple straightforward relation between steady temperature and time required to produce a definite quality change. In handling frozen foods, however, we are rarely, if ever, dealing with steady temperatures, but with a series of variable temperature excursions. A graphical example of the possible temperature changes encountered in

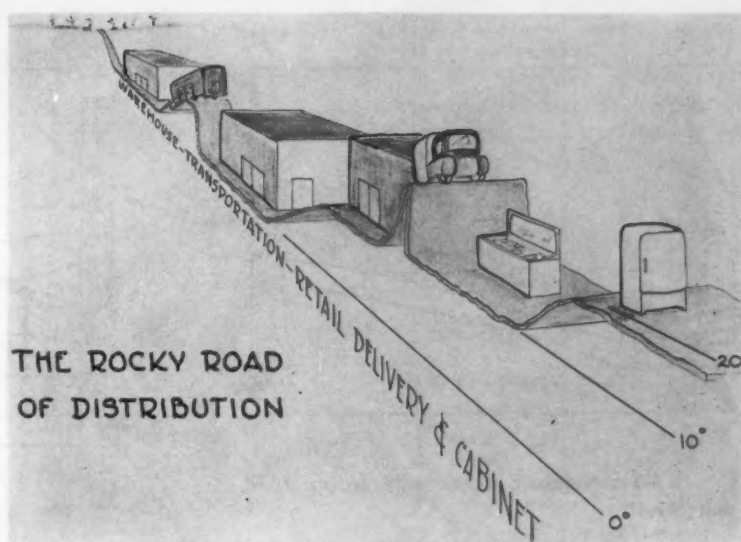


Fig. 1 Possible temperature changes during the distribution of frozen foods

distribution is illustrated in Fig. 1. The problem is how to evaluate these variable temperature changes in terms of the degree of quality change which is measurable accurately by a trained taste panel and defined here as the high quality life of the product. We have developed a simple procedure of evaluating these variable temperature histories by means of graphical integration.

Quite briefly, the procedure involves the construction of a co-

Table I. Time-Temperature Combinations Which Cause Equivalent Quality Changes In Some Frozen Fruits and Vegetables

Temperature F	Time
0	1 year
5	5 mos
10	2 mos
15	1 mo
20	2 wks
25	1 wk
30	3 days

ordinate system in which time is represented on a uniformly spaced horizontal axis and the temperature scale is spaced in proportion to the relative rate of quality change at the temperatures assigned to the scale. An example of such a coordinate system derived from the relative rate of quality loss in strawberries is shown in Fig. 2. The only requirement for construction of such a system is a knowledge of the relative rates of quality change at various steady temperatures. These are available

for a number of commodities from our time-temperature tolerance investigations.

Since different commodities usually have somewhat different temperature coefficients, it is necessary to construct a separate coordinate system for each commodity. Since the temperature scale is spaced to correspond to the relative rate of quality loss at the specific temperature, and the time scale is linear, the area under any given irregular temperature history plotted in this coordinate system is proportional to the total quality loss. In order to express this total quality loss in more familiar terms, we can divide the measured area under the curve by the time that the product was exposed to the variable temperature and obtain the effective temperature for the duration of the experience.

A more convenient way to express this total change is in terms of the equivalent time at some chosen steady reference temperature, such as 20 F, that will produce the same change as the irregular temperature pattern. In this case, the area under the curve is divided by the relative rate of change at the reference temperature. Since we know the length of time it takes trained taste panels to detect a real quality change at various steady temperatures, we can express the effect of any given temperature history in terms of a frac-



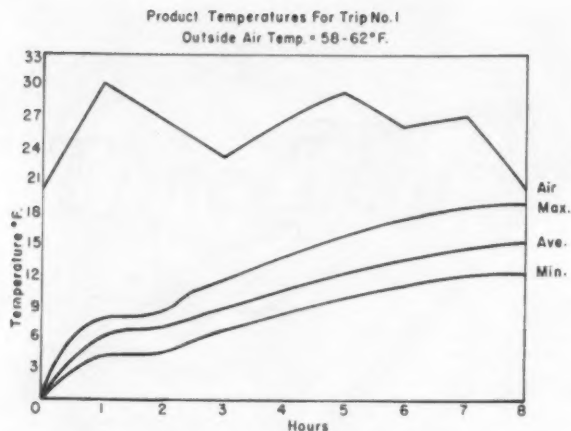


Fig. 3 Temperature changes in frozen food delivery truck No. 1

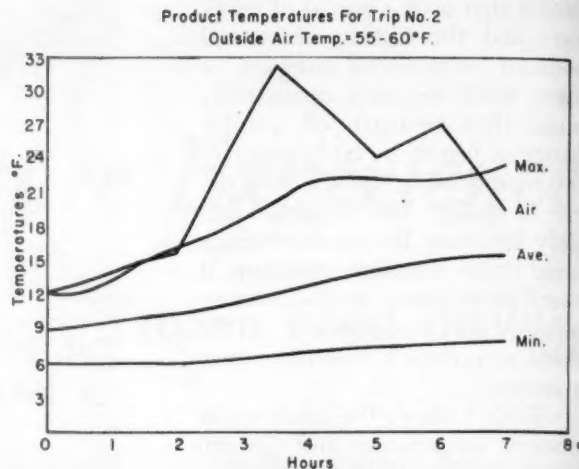


Fig. 4 Temperature changes in frozen food delivery truck No. 2

tion or percentage of this time. For example, this time interval or average high quality life for strawberries held at 20 F is 10 days, and since the irregular pattern in Fig. 2 caused a change equivalent to 7.5 days at 20 F, this specific time-temperature experience caused a 75% loss in the high quality life of strawberries. If the area under any given irregular temperature history is divided by the area which corresponds to high quality life, the quotient will express the total quality change in terms of a fraction or multiple of the high quality life.

By this procedure, it is possible to evaluate the relative effect of various commercial practices. During this past year, we had the opportunity of obtaining tempera-

ture measurements in a few selected frozen food delivery trucks in the Bay Area. Product temperatures were measured in nine locations along side walls and ends at hourly intervals during actual delivery runs on trucks normally used for this purpose. Product and air temperature changes for the duration of three trips are shown in Figs. 3, 4 and 5. These time-temperature curves were plotted in a coordinate system similar to the one shown in Fig. 2 and the quality changes were calculated as outlined above.

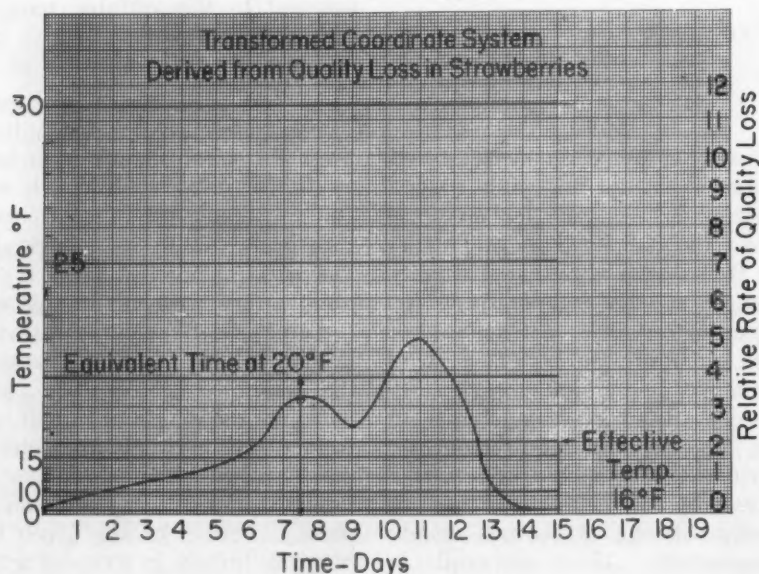
Quality losses during cooling to 0 F after placing in a retail cabinet were estimated by inserting thermocouples in individual packages placed in still air at 0 F and

calculating the effect of the resulting cooling curve. Table II shows the results obtained for cooling losses only. It should be noted that the large difference in quality loss between 30 and 25 F reflects the effect of the latent heat of freezing which involves a considerable length of time as well as a high temperature.

Table III shows the effect of both temperature rise and fall for the three distribution runs shown in Figs. 3-5. It will be noted that even though product temperatures as high as 22 F were encountered in these delivery runs, the total calculated loss in high quality life for the highest temperature was of the order of 8%. This is about 1/12 of the change required to be detectable by a trained taste panel or 1/12 of the change which normally occurs during a year of storage at 0 F. This is obviously but a minor effect in terms of quality change even though relatively high temperatures are involved. Furthermore, calculations based on average temperatures instead of the highest indicate a loss in high quality life of but about 3%. The principal reason for these minor quality changes is due to the fact that delivery is accomplished in a relatively short period.

A few years ago, the Agricultural Marketing Service issued a report (No. 176, May 1957) on temperatures in frozen food delivery trucks with and without curtains. Since these were rather extensive tests covering a substantial period of time, calculations of quality

Fig. 2 Coordinate system for estimation of quality losses under variable temperature conditions



Product Temperatures For Trip No. 3  
Outside Air Temp. = 105-120° F.

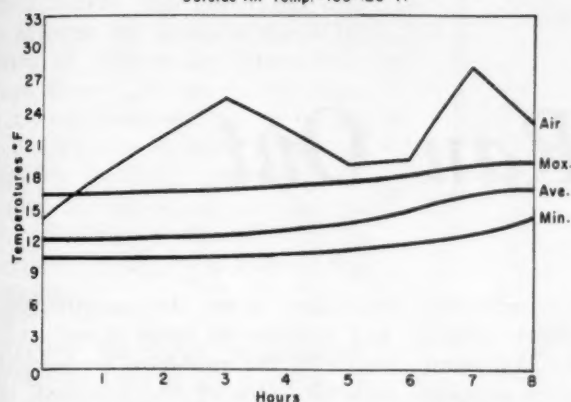


Fig. 5 Temperature changes in frozen food delivery truck No. 3

losses were made using the temperature data obtained on trucks without curtains. Calculations were based on an average temperature rise from 0 to 20 and back to 0 F. The pertinent data and results of the quality calculations are summarized in Table IV.

While there is no doubt that worse conditions can be found, these results demonstrate that everyday normal delivery practice can be accomplished without significant quality change. The seriousness or lack of seriousness of any given practice can only be determined when the entire integrated time-temperature experience is evaluated as was done in the distribution examples illustrated here.

#### PERHAPS MOST IMPORTANT

Now let us take a brief look at another operation which is common to all frozen foods—namely, the freezing operation itself. While the pallet freezing operation we will discuss here is a special kind of freezing, a major proportion of fruit products are frozen in this manner. The operation involves

Table II. Quality Loss During Cooling of Individual Packages in Still Air at 0 F

Temperature Range	Approximate Values for:	
	Equivalent Time at 0 F in Days	Percentage Loss in High Quality Life*
From 30 to 0 F	73	20
From 25 to 0 F	29	8
From 20 to 0 F	11	3
From 15 to 0 F	7	2
From 10 to 0 F	4	1

\*Calculations based on strawberries which have an average high quality life of 1 year at 0 F

casing and palletizing at room temperature and freezing in tunnels or sharp freeze rooms. We recently completed a survey of actual com-

Table III. Equivalent Effects of Times and Temperatures Encountered in Distribution of Frozen Food.

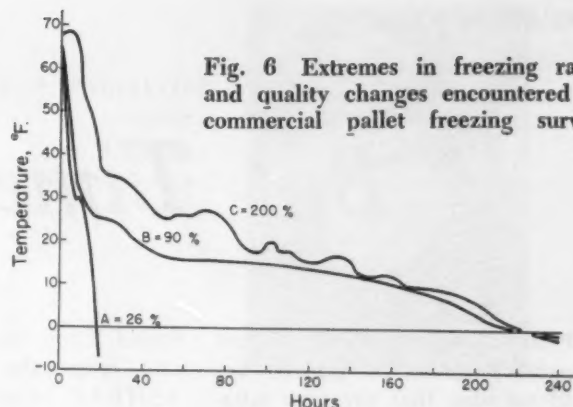
Trip No.	Temperatures Considered	Percentage Loss in High Quality Life*			Equivalent No. of Days at 0 F
		During Temp. Rise	During Cooling to 0 F	Total	
1-8 hr	Lowest	0.6	1.6	2.2	8
	Highest	1.4	2.9	4.3	16
duration 2-7 hr	Average	0.7	1.9	2.6	10
	Lowest	0.4	1.0	1.4	5
	Highest	2.6	5.5	8.1	30
duration 3-8 hr	Average	0.8	1.9	2.7	10
	Lowest	1.1	1.4	2.5	9
	Highest	2.2	3.0	5.2	19
duration	Average	0.4	1.9	3.3	12

\*Calculation based on rates of quality loss in strawberries.

mercial pallet freezing practices in strawberry freezing plants on the west coast. The objective of the survey was to determine the range of time-temperature patterns encountered under actual practice and to evaluate them in terms of the quality losses or changes which are attributable directly to the freezing conditions. In order to evaluate the freezing rate curves, quality data at temperatures from 70 to 0 F were obtained and used to construct a coordinate system similar to the one in Fig. 2.

A total of 75 freezing rates were evaluated by the integration procedure outlined above. When the calculated quality losses which occurred as a result of these freezing rates were averaged, we found an average loss equivalent to about

Fig. 6 Extremes in freezing rates and quality changes encountered in commercial pallet freezing survey



79% of the high quality life or storage at 0 F for 9-10 months. Fig. 6 shows the extremes in freezing rates encountered in the entire survey together with percent loss in high quality life. It is important to note that under the most un-

favorable condition, 200% of the high quality life was lost or used up. This is a rather marked quality change. In fact, we might say that the berries which experienced this specific freezing rate were al-

(Continued on page 83)

Table IV. Equivalent Effects of Times and Temperatures Encountered in Distribution of Frozen Foods

Number of separate trips	20
Avg. time for each trip	8 1/2 hr
Avg. number of stops per trip	33
Avg. outside air temp.	80 F
Avg. product temp. rise	20 F
Calculated equiv. storage time at 0 F	18 days
Calculated loss in high quality life	5%

The average calculated loss of approximately 5% of the high quality life corresponds quite well with the three tests of this type which we have just illustrated.



# But Time Ran Out

Last August when I wrote my first Research Page for the JOURNAL, I had no idea that my next communication to the membership would be prepared under such completely different circumstances. Perhaps you will recall the title, "The Strongest Possible Program at the Laboratory."

At that time the Research and Technical Committee, with the help of its appointed Panels and the staff at the Laboratory, had begun to make some quite detailed plans for the programs at the Laboratory. A sample of the type of planning that was undertaken will be found in the description of the proposed environmental program that appeared in the January JOURNAL. The objective was to establish detailed planning for a period of at least two years and make these plans available for discussion and refinement. It was our hope that through the preparation of a sound prospectus in each project area, enthusiastic support would be

found from Society membership and from the industries which ASHRAE represents. We even anticipated that industry support might take the form of substantial financial contributions made in the interest of achieving the proposed objectives.

But time ran out. On December 9 the Board of Directors deliberated and accepted the recommendations of the Long Range Planning Committee report, which advised closing down and liquidating facilities of the Society's Research Laboratory at Cleveland and substantial expansion of our research programs in cooperating institutions. (For details refer to the JOURNAL, January, page 54.)

As might be expected, the Research and Technical Committee took a somewhat different viewpoint on the question of abandoning the Laboratory. It seems to us that at least one more effort should be made to construct a worthwhile program and generate the support

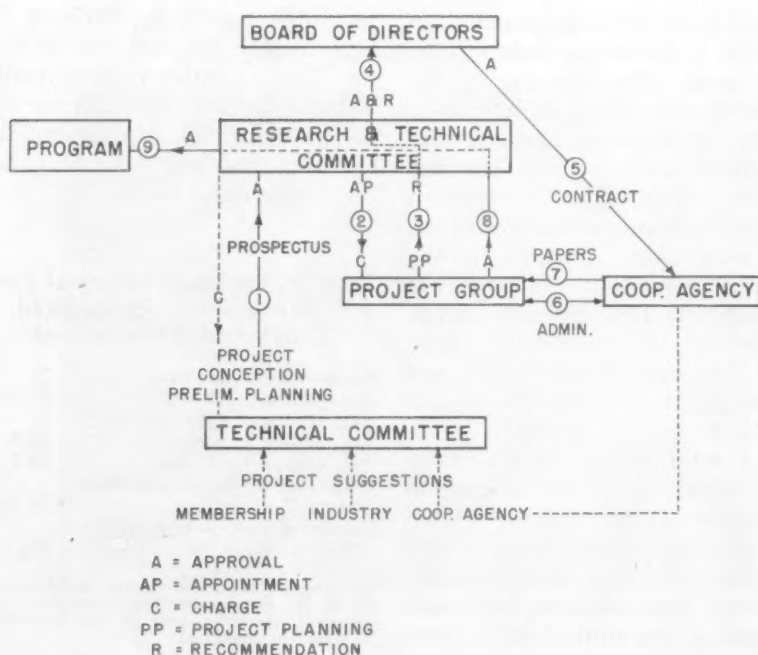
necessary from the membership and industry to carry it out. Admittedly, the problems were most difficult. One of the toughest, of course, is that of attracting outstanding leadership for the operation.

Now that the policy has been established, the Research and Technical Committee has begun a vigorous attack on the many problems arising from the decision. The remainder of this communication will deal with some of the major ones.

**Conclusion of the work in progress at the Laboratory:** Here decisions must be made as to the best point to terminate each project. The objective, of course, is to obtain the maximum usefulness from the data gathered. If work is stopped abruptly, a great deal of effort already expended can be wasted simply because the data at hand are insufficient to complete a report covering a discrete problem. For example, in the environmental program we were only a little more than half way through the gathering of data on comfort sensations under symmetrical radiation conditions with light and heavy clothing. Before closing down this project it has been decided to complete this specific portion of the work. We believe this can be accomplished by about mid-April. In fact the only programs that cannot be concluded prior to this time are the Heat Meter and Animal Calorimeter projects, which are being executed under government contract. These will be completed by June 30.

**Disposing of facilities and equipment:** Over the years the Laboratory has assembled some quite valuable research facilities. The three most important are the Environmental Room, the Odor Rooms, and the Solar Calorimeter. The Environmental facility by itself

Fig. 1 Research project history



represents a capital investment of over \$150,000. It is imperative that we attempt to relocate these facilities in cooperating institutions where there is an impelling interest in their continued use. It would be unfortunate indeed if one of these fine facilities, after being relocated, should stand idle due to lack of either technical staff to operate it or money to finance the programs.

**Sustaining the level of research activity:** Implied in the decision of the Board is the charge to R/T Committee to continue the Society's research program at a substantial level through cooperative programs. This appears to be one of our most difficult assignments. Methods used in the past for establishing worthwhile programs of this type may prove highly inadequate. I suspect it may be some time before we can develop effective machinery for defining and assigning the segments of our new program.

**Committee reorganization:** The administration of a vigorous research program without the Laboratory and its staff poses a number of new problems. With the Laboratory we had relatively few large scale projects of a continuing nature and recently these have been of a more fundamental nature. Without a Laboratory much more committee effort will be required to generate and monitor the increased number of projects in cooperative institutions. The work will be in smaller packages and scattered geographically. There is some thought that it should be of an applied rather than fundamental type and perhaps more closely aligned with industry problems.

For these reasons the R/T Committee has concluded that it must reorganize its structure, eliminating the RAC's which have quite broad scopes, such as Energy Transfer, Mass Transfer, etc. Preliminary thinking indicates that the preferred approach is to form a single committee much like the present Technical Division of the R/T organization. However, we plan to organize it substantially along industry lines with divisions somewhat as follows:

1. Heating (4.5)(4.7)
2. Ventilating (6.4)

## E. P. PALMATIER

Chairman

ASHRAE

Research and Technical Committee



3. Refrigeration (2.1)(2.3)(4.3)(8.7)
4. Air Conditioning and Environment (4.1)(4.2)(6)(7.7)
5. Food Science and Refrigeration (4.2)(7.3)(7.8)(7.9)(8)
6. Domestic Refrigerators and Food Freezers (7.2)
7. Systems and Controls (3.1)(4.4)(4.6)
8. Insulation and Vapor Barriers (1.11)
9. Equipment - Basic, Unitary, Auxiliary (2)(3)(7)
10. Basic Sciences (1)(5)

The numbers in parenthesis indicate possible reassignment of present technical committees under the new divisional structure. The Coordinators or Division Heads of this organization would be appointed by the Board of Directors and together with a Chairman and Vice-Chairman would constitute the new Research and Technical Committee. This committee would administer the research program.

**Project administration, initiation and financing:** As in the case of the discussion above on organization, much of the thinking regarding project administration and financing must be considered preliminary. Considering first the amount and source of funds, we might establish

a short term objective of \$200,000 derived as follows:

International Exposition Co. . .	\$ 70,000
Membership Contribution (Dues) . . . . .	30,000
Industry Sponsored Research . .	100,000
Total	\$200,000

Of this, approximately 15% or \$30,000 would be required to run the staff research office at headquarters, leaving a net of \$170,000 for actual project expense.

The net figure of \$85,000 derived from the Exposition Co. contribution and the membership would be utilized largely for research in the public interest and to encourage and assist academic research workers in the fields of interest to the Society generally. It is likely that this work will tend more toward the fundamental rather than applied research.

The industry sponsored part of the program will be initiated and administered by committees composed of members dedicated to the solution of some common industry problem. It is anticipated that the project proposal will usually originate within one of the Technical Division subcommittees. If the R/T Committee is convinced that the project is worthy of Society

(Continued on page 90)

## PROPOSED RESEARCH AND TECHNICAL GROUPS

- |   |  |
|---|--|
| 1. HEATING  | 8. BASIC SCIENCES AND MATERIALS<br>(HEAT TRANSFER, FLUID FLOW, PSYCHROMETRICS, ETC.) |
| 2. VENTILATION  | 9. SYSTEMS - CONTROLS  |
| 3. REFRIGERATION  | 10. INSULATION AND VAPOR BARRIERS  |
| 4. AIR CONDITIONING   | 11. EQUIPMENT (BASIC, UNITARY, AUXILIARY)  |
| 5. FOOD SCIENCE AND REFRIGERATION                           | 12. HEATING AND COOLING LOADS  |
| 6. DOMESTIC REFRIGERATORS AND FOOD FREEZERS                 |  |
| 7. ENVIRONMENT (PHYSIOLOGY, ODOR, ACOUSTICS, AIR POLLUTION) |  |



## Meetings ahead

- April 5-7** — Gas Appliance Manufacturers Association, Annual Meeting, Boca Raton, Fla.
- April 5-7** — Institute of Environmental Sciences, Annual Meeting and Exposition, Washington, D. C.
- April 11-14** — 2nd International Refrigeration and Air Conditioning Exhibition and Technical Convention, sponsored by World Refrigeration, London, England.
- April 20-22** — Refrigeration Research Foundation, Annual Meeting, Palm Beach, Fla.
- April 23-27** — National Association of Refrigerated Warehouses, Annual Meeting, Palm Beach, Fla.
- April 23-27** — Oil Heat Institute, 39th Annual Convention, Washington, D. C.
- May 16-18** — Building Research Institute, Spring Conferences, Washington, D. C.
- May 21-24** — Industrial Heating Equipment Association, Hot Springs, Va.
- May 22-25** — Design Engineering Show, Detroit, Mich.
- June 11-14** — American Society of Mechanical Engineers, Summer Annual Meeting, Los Angeles, Calif.
- June 12-15** — National District Heating Association, 52nd Annual Meeting, Portsmouth, N. H.
- June 12-15** — Institute of Boiler and Radiator Manufacturers, Annual Meeting, Absecon, N. J.
- June 25-30** — American Society for Testing Materials, Annual Meeting, Atlantic City, N. J.
- June 26-28** — American Society of Heating, Refrigerating and Air Conditioning Engineers, 68th Annual Meeting, Denver, Colo.
- October 2-4** — American Gas Association, Annual Convention, Dallas, Texas.
- November 6-10** — National Warm Air Heating and Air Conditioning Association, 48th Annual Convention, Chicago, Ill.

## News of ASHRAE members

### New jobs

**Richard B. Flynn** has been appointed Sales Manager of National Copper and Smelting Company. A graduate of Detroit Institute of Technology, he had served with Wolverine Tube Div of Calumet & Hecla, Inc., for 13 years prior to accepting this new post.

**Anthony J. De Fino**, Hupp Vice President\* and General Manager of Perfection Div, has been named Group Vice President by Hupp Corporation, a post established to reduce the number of divisions reporting directly to the president. With Hupp since 1957, he previously had been Vice President and General Manager of Servel Inc.'s All-Year Air Conditioning Div and of Fedders-Quigan Corporation's Buffalo Div. An alumnus of Cornell University, he has served as President and Chairman of the Executive Committee of Air Conditioning and Refrigeration Institute.



**William H. Divine** is now Assistant General Sales Manager, Engineered Machinery Div, York Div, Borg-Warner Corporation. A 1941 graduate of the U. S. Naval Academy, he resigned his commission in 1947. Product Specialist in the Air Conditioning Div of General Electric Company until 1952, he then joined the York Field Sales Department.

**Seymour W. Brown**, formerly of S. W. Brown Consulting Engineers, is now President of Hi-Press Air Conditioning of America, Inc., and Drayer-Hanson Div of Hi-Press.



**E. R. Pierce** advances from his post as Manager of York Contractors to General Manager, Packaged Products Branches, York Div, Borg-Warner Corporation. A mechanical engineering graduate of the University of Maryland, he was associated previously with General Electric Company.

**Donald W. Kuhn** has been appointed Manager of the Kansas City district office of Armstrong Cork Company's Insulation Div. He joined the company in 1956, following graduation from Milliken University. Also announced was creation of a new district office in Los Angeles, with **J. A. Crawford** named Manager. He has served as a salesman since joining the company in 1954.

**Bruce A. Stahl**, in his new post as District Manager of the Houston office of Vilter Manufacturing Company, will supervise sale of refrigeration, air conditioning and heat transfer equipment. A graduate of the University of Illinois, he has been with the company since 1958.

**Arnett S. Smiley**, with York Div of Borg-Warner Corporation for 18 years, has been named Manager of Refrigeration Sales. After graduation from Purdue University in 1942, he joined York's graduate engineer training program. He has been serving most recently as Refrigeration Sales Engineer with headquarters in Cincinnati, Ohio.

**Lawrence C. Felder**, formerly with General Electric Company, Sunderlin Organization and Virginia Metal Products, has been appointed Field Sales Manager, Air Conditioning Div, Remington Corporation. Most recently with Virginia Metal Products, where he served as President, he was with General Electric Supply Company as National Sales Manager from 1944 to 1952, and as a product line manager for the Laminated Products Div from 1952 to 1957.

**Linn Helander**, ASHRAE Fellow and Professor and Head of the Department of Mechanical Engineering of Kansas State College from 1935 until his retirement in 1957, is working currently in Sao Jose dos Campos, Brazil, under a contract with the U. S. International Cooperation Administration. His assignment is to establish an advanced engineering program at the Aeronautical Institute of Technology, training two men to teach the course when he leaves. Professor Helander's teaching career began in 1931 with an appointment as Assistant Professor of Mechanical Engineering at the University of Pittsburgh. He left there upon his appointment to Kansas State College in 1935. A member of the former ASHAE since 1948, he was elevated to the grade of Fellow in 1960. He has spoken at several Society meetings and is the author of numerous articles which have been published in technical and scientific journals. Activities in the Society have included Chairmanship of the TACs on Air Distribution and Roof Ventilation. A Fellow of the American Society of Mechanical Engineers, he served a term as ASME Regional Vice President.



## Others

are saying—

**physical height . . .** of a multi-story building is an important factor in design and selection of air conditioning systems best suited for this application. With increase in height of a building, there is a rise in the height of water column or hydrostatic pressure on the distribution system, and the distribution system itself will need a more extensive piping network, which will require an increase in the dynamic pressure needed for circulation of the water through the system. Considered in this article is the problem of splitting a chilled water system so that pressures will be held down to within the range of standard equipment. *Air Conditioning, Heating and Ventilating, March 1961, p 53.*

**acoustical treatment . . .** of air handling equipment in residential, commercial and industrial buildings provides significant benefits. Cited procedure for designing a quietly-operating system includes: determination of satisfactory noise levels on the basis of occupancy requirements and of noise levels produced by machinery and air handling equipment; eliminate leakage paths, whether through the walls or holes; provide adequate vibration isolation for equipment, piping and ducts; design the cooling tower and intake and exhaust systems to prevent noise problems; and review the noise control design, following the completion of the system design. *Consulting Engineer, March 1961, p 112.*

**sizing refrigerant lines . . .** presents three problems: creating a pressure gradient or differential between the sources and the point of delivery, sizing the piping system sufficiently large so that the pressure drop caused by frictional resistance is not unduly high and insuring that oil returns to the compressor. This article is intended as an aid to the operating engineer in locating trouble areas on blueprints. *Industrial Refrigeration, December 1960, p 8.*



**Herbert P. Tinning** has joined Virginia Smelting Company as a Water Chemical Field Engineer. He will work from the company's New York office and will be in charge of the New England and Middle Atlantic states. Former Assistant Secretary—Membership for precedent ASRE, he is a graduate of Stevens Institute of Technology. Prior to joining Virginia, he was associated with Dunham-Bush, Inc.

**James Alan Lynch**, a graduate of California State Polytechnic College, has been appointed Sales Engineer for the Los Angeles area by Dunham-Bush, Inc. He was formerly with the U.S. Naval Ordnance Test Station and Comeau Engineering. Appointed Sales Engineer in the Oklahoma City area is **John R. Henderson, Jr.** His past affiliations were with York Corporation and J. R. Henderson Company.

### Necrology

**Cleve A. Sewell**, Vice President of Tenney Engineering, Inc., died recently at the age of 48. He had been a member of the Society since 1945.

**Abe Corbman**, President of Adelta Manufacturing Company, Inc., died on November 23, 1960. He was 62.

**Leon L. Sawyer** was 69 at the time of his recent death. He had been affiliated with J. S. Brown-E. F. Olds Plumbing and Heating Company.

**John B. Coleman**, a Life Member who joined the former ASHVE in 1920, died on December 24, 1960, at the age of 81.

**Kalman Steiner**, President of Central Fuel Company of Maryland, Inc., died on December 6, 1960. Born in 1902, he was educated at Illinois Institute of Technology.

**Sewell O. Jordin** died on December 28, 1960. He had been a mechanical engineer with the Engineering Div of 5010th Inst. Squadron.

**Melvin H. McWilliams** of Phoenix Chapter died February 5. He had been associated with Marley Company.

**Vivian F. R. Berton**, an architect with the Building Construction Branch of the Canadian Department of Public Works, died recently at the age of 59. He had served on the Nominating (1958) and Membership (1958-59) Committees of Ontario Chapter.

**Fred A. Crawford**, deceased, had been the owner of Home Comfort Heating Company. He was 68.

**Arthur H. Foster** died recently at the age of 58. Prior to his death he was a salesman for Refrigerative Supply, Ltd.



# What ASHRAE Regions and Chapters are doing

School air conditioning received extensive notice at these first meetings of the new year. Also covered were such diverse topics as solar heating, use of ammonia as a refrigerant, electronic air cleaning, dampers and steam traps.

**CENTRAL MICHIGAN** . . . Loss of dielectric strength in insulation, causing insulation damage, was cited by T. Peihl of Tecumseh Products, speaking at the February 21 meeting, as a major cause of hermetic compressor burnout. An indicated solution was development of higher temperature insulations that would be compatible with refrigerants and refrigeration oils. Factors involved in motor breakdown were given as electrical, mechanical and chemical failures, manufacturing faults and careless handling. Electrical failures consist of high or low line voltage, electrical component deficiencies, poor application of overloads and capacitor and turn-to-turn failures. Mechanical problems usually result from breakdowns of the ends of the windings due to forces set up in the ends of the motor or vibration due to rotor imbalance.

**ILLINOIS** . . . Meeting on January 9, members had a choice of two lectures, "Freeze Drying" and "Industrial Ventilation".

**KANSAS CITY** . . . Advantages and disadvantages of air-cooled condensers were pointed out at the February 6 meeting by David M. Dart of Marley Company, who emphasized the importance of proper sizing. He contended that it is useless to size condensers large enough to keep a normal head pressure for the few days of the year when temperatures are abnormally high. By use of charts, he showed the feasibility of use of smaller condensers.

**who's doing what** . . . Harold O. Betz is head of the local UEC Building Fund Drive.

**ST. LOUIS** . . . Tracing the history of heating from prehistoric times to the present day, Henry E. Voegeli, American Brass Company, attached special emphasis to the problem of conservation of energy and centered his discussion on newer heating ideas, such as solar heat. Current forms of heating, including atomic power, he said, have limitations and at some future date will be exhausted completely.

Storage problems have led to extensive research in this field, to assure that solar heat will be available when needed in cold weather. For experimental

purposes, speaker Voegeli has installed a ground heat pump using  $\frac{3}{4}$ ,  $\frac{1}{2}$  and  $1\frac{1}{4}$ -in. OD copper pipe loops placed at three, five and seven-ft depths, with halogenated hydrocarbon refrigerant circulating in the tubes.

**who's doing what** . . . Bruce Evans, John Schenk, Everett Carlson, Robert Waites and Charles Hastings have been elected to the Nominating Committee. F. Edward Ince will be in charge of the joint meeting with Kansas City Chapter, to be held at the University of Missouri in April.

**CINCINNATI** . . . Importance of architectural design to achieve the best environment for learning was stressed by Z. A. Marsh of Minneapolis-Honeywell Regulator Company in his talk on "School Air Conditioning", February 7. By a series of slides he showed that it is possible to have air conditioned schools at approximately the same or lower cost than non-air conditioned schools, when the architect designs the school for this purpose, utilizing compact design with interior class rooms rather than the open type with large window areas.

**who's doing what** . . . C. J. Kummer will be liaison representative to the Career Guidance Committee, to serve on their annual program March 8, 28, 30 and April 1.

**DALLAS** . . . Consulting Engineer George Gregerson discussed "The Consulting Engineer's Interests in our Profession" at the January 16 meeting. Among points covered was the position of the engineer with respect to the contractor, manufacturer's representative and architect. Speaker Gregerson stated that changes to specifications should be in writing as addenda.

**who's doing what** . . . R. Kirkpatrick assumed the Presidency of this Chapter at the January meeting. James Mays will serve as head of the local UEC Building Fund Drive.

**LONG ISLAND** . . . Dr. Sidney Sussman, Chief Chemist of Water Service Laboratories, spoke at the January 9 meeting on "Water-Caused Problems in Air Conditioning and Refrigerating Systems".

**who's doing what** . . . William Evanchick and Robert

## CHAPTER MEETING DATES

	Apr.	May	June		Apr.	May	June		Apr.	May	June
Alamo	—	—	—	Central Pennsylvania	12	10	—	Illinois	10	8	—
Arkansas	18	16	20	Cincinnati	—	—	—	Illinois-Iowa	17	15	—
Atlanta	10	—	—	Cleveland	10	8	—	Inland Empire	10	8	11
Austin	20	18	15	Columbus	17	15	19	Iowa	10	8	11
Baltimore	6	4	—	Dallas	17	15	19	Jacksonville	—	—	—
Baton Rouge	18	16	—	Dayton	11	—	—	Johnstown	11	9	—
Boston	—	—	—	El Paso	17	15	19	Kansas City	14	1	—
British Columbia	12	10	—	Evansville	4	2	3	La Ville de Quebec	11	9	—
Central Arizona	3	1	2	Florida West Coast	—	—	—	Long Island	—	—	—
Central Indiana	11	9	—	Fort Worth	19	17	21	Louisville	10	8	—
Central Michigan	11	9	13	Golden Gate	—	—	—	Manitoba	27	25	—
Central New York	—	17	—	Hampton Roads	4	2	6	Memphis	17	15	19
Central Oklahoma	10	8	—	Houston	21	19	16	Michigan	17	—	—



Grygo have been elected to the Nominating Committee.

"Air Conditioning in Schools" was the topic presented at the February 13 meeting, when Z. A. Marsh of Minneapolis-Honeywell Regulator Company was guest speaker.

**who's doing what** . . . Proposed by the Nominating Committee as officers for the 1961-62 season are: S. Gayle, President; W. Kane, Vice President; K. Henry, Recording Secretary; B. Maxwell, Financial Secretary; and L. Bloom, Treasurer.

**CENTRAL ARIZONA** . . . With the help of slides illustrating the increasing problem of air pollution in the Phoenix area, Patent Attorney Willard Leblond Groene spoke at the February 6 meeting.

**who's doing what** . . . Walter Biddle (Chairman), Frederic W. Gabbard, James B. Hoaglund, Edwin P. Boothroyd and Fred A. Anderson are recently elected members of the Nominating Committee. George Jackson gave details of the proposed program for the Region X Meeting, to be held in Phoenix April 28 and 29.

**BALTIMORE** . . . Use of "Ammonia as a Refrigerant" was discussed at the February 2 meeting by Clarence Smith of Frick Corporation. His talk was followed by a question and answer period.

**who's doing what** . . . R. F. Weisman is working on preparations for Engineer's Week. William Kruger reminded members of the UEC Building Fund Drive. John Engalitcheff, Edward J. Morris, William Robertson and Edgar J. Dull were elected to the Nominating Committee.

**MIDDLE TENNESSEE** . . . Members of a panel which spoke at the January 16 meeting were James Ragon, Moderator; Thomsen Guth, Architect; S. L. Burns Jr., Mechanical Engineer; and Turk O. Humphrey Jr., Mechanical Engineer. Information is relayed from the engineer to the suppliers and the contractors in two ways, stated speaker Burns — the plans and the specifications. The importance of clear and comprehensive plans and specifications was cited by Engineer Humphrey, and Architect Guth discussed coordination of architectural and mechanical plans and specifications.

**IOWA** . . . Importance of insulation for practical and economical electric heating was emphasized by February speaker Robert Boyd of E. L. Weigand Company. Proper insulation of roofs was illustrated by

slides. It was noted that insulation in drop ceilings is more effective than insulation as a part of the roof deck. Slides showed evaluation of a school heating plant, comparing electric heating with a boiler. Electric heating proved comparable when such costs as boiler replacement and maintenance were considered.

**BRITISH COLUMBIA** . . . "A Trip to Russia", made with 12 other engineers, was the subject of January speaker H. M. Ellis of International Power and Engineering Consultants, Ltd. Dr. Ellis showed slides of various power plants, dams and buildings under construction.

**who's doing what** . . . Selected for the Nominating Committee are Elliot Schmidt, Charles Turland, Cliff White, Albert Martin, Ken McConnell and Daniel Thomson.

**WESTERN MICHIGAN** . . . "Sizing of Refrigeration System Pipelines for Optimum Economy", a paper presented at the Semiannual Meeting in Chicago by Professor Donald J. Renwick of Michigan State University, was previewed by him at the February 6 meeting. Covered were pipe selection charts, which allow for changing conditions so that alternate design factors can be compared by the refrigeration engineer. The fundamental analysis for constructing the charts was included and additional factors of importance in pipe sizing were discussed.

**SAN DIEGO** . . . Meeting jointly with the local chapter of ASME, members attending the January 10 meeting heard H. L. Barnebey of Barnebey-Cheney Company speak on "Employment of Activated Charcoal in the Removal of Atmospheric Odors and Those Originating Within Occupied Spaces."

**who's doing what** . . . Newly elected members of the Nominating Committee are F. Antelline, W. Nield, W. Hermes, E. H. Linberg and R. Townsend.

**NEW ORLEANS** . . . Discussing "Planning an Air Conditioned School on a Present Day Budget" at the February 21 meeting were C. C. Miller, Superintendent of Schools, Terrebonne Parish; N. C. Curtis, Jr., Partner, Curtis and Davis; and T. A. Stokes, Engineer, Cary B. Gamble and Associates. Superintendent Miller opened the discussion with a brief talk on controlled environment in schools, explaining advantages to be derived. He pointed out that controlled atmospheric and lighting conditions create an excellent learning environment.

Speaker Curtis touched on design and suggested that architects and engineers should work

	Apr.	May	June		Apr.	May	June		Apr.	May	June
Middle Tennessee	11	9	13	Northern Alberta	—	—	—	San Joaquin	—	—	—
Minnesota	10	8	—	Northern Connecticut	13	18	—	Savannah	—	—	—
Mississippi	24	22	26	Northern Ohio	—	—	—	Shreveport	20	18	15
Mobile	24	22	26	Ontario	11	1	—	South Carolina	17	15	—
Montreal	17	15	—	Oregon	13	11	15	South Florida	11	9	—
National Capital	12	10	—	Ottawa Valley	—	—	—	South Piedmont	—	—	—
Nebraska	11	9	13	Panama & Canal Zone	—	—	—	Southern Alberta	18	16	20
New Mexico	—	—	—	Philadelphia	13	25	—	Southern California	10	8	15
New Orleans	18	16	—	Pittsburgh	17	15	—	Southern Connecticut	13	11	8
New York	25	23	—	Puget Sound	11	9	—	Toledo	3	8	—
Niagara Frontier	8	1	5	Rhode Island	12	10	—	Tucson	4	9	—
Niagara Peninsula	4	2	—	Richmond	—	—	—	Utah	21	19	—
North Alabama	—	—	—	Rochester	5	17	—	West Texas	28	26	—
North Jersey	—	—	—	Rocky Mountain	—	—	—	Western Massachusetts	20	18	16
North Piedmont	14	12	—	Sacramento Valley	—	—	—	Western Michigan	10	—	—
Northeastern New York	18	15	—	St. Louis	17	15	—	Wichita	17	15	—
Northeastern Oklahoma	—	—	—	San Diego	11	9	13	Wisconsin	17	15	—

more as a team, that the work of each must blend with that of the other. Savings on non-mechanical items as a result of a design made possible through air conditioning were shown to be more than equivalent to added costs of mechanical equipment in a cited installation.

Mechanical equipment of South Terrebonne High School, especially the air conditioning system, which has a total capacity of 270 ton, was covered by T. A. Stokes. He explained how studies were carried out to determine comparative initial and operating costs of an air conditioned structure as related to a non-air conditioned building. Auditorium and stage of the high school each have a separate pumping system and can be cooled from a chilled water storage system without operation of the entire system. Classrooms are treated by ventilation-type units mounted on the outside walls. Pumping systems are designed to operate by zones, with several classrooms grouped in each zone, for optimum efficiency.

**OTTAWA VALLEY . . .** Speaking for the United Engineering Center campaign, Charles Rink of Industrial Acoustics Company, February guest speaker, presented members with an idea of the fundamental purpose of this project. Following this, he reviewed the GUIDE AND DATA BOOK Chapter on Sound Control, using charts to show calculation of sound elimination in fans and ducts.

**NORTH PIEDMONT . . .** Fixtures combining lighting and air diffusion equipment were discussed by January speaker H. L. Cushman of Pyle-National Company.

Discussion of "Reversing Valves in Heat Pump Applications," presented at the February 10 meeting by Paul E. Bartels of Alco Valve Company, indicated that heat pumps present certain control problems.

**who's doing what . . .** Samuel T. Oliver elected Chairman of the local UEC Fund Drive at the January meeting, made a preliminary report on the campaign.

**WESTERN MASSACHUSETTS . . .** Development of packaged air conditioners in the last fifteen years was the topic of John Roth, Vice President and Product Manager for Dunham-Bush, Inc., who spoke at the January 30 meeting. Schematic diagrams were shown of integral parts of the system. Flexibility of this type of unit was detailed and speaker Roth discussed applications with water towers, evaporative condensers, heating coils and air-cooled condensers.

In the second phase of his talk, he dealt with adaption of roof-top units for both heating and cooling applications. Space-saving features were covered. Speaker Roth concluded with a discussion of package-system applications.

**NIAGARA FRONTIER . . .** Design and construction of the containment, reactor and boiler of the atomic powered merchant ship, N. S. Savannah, were discussed at the January 9 meeting by C. H. Lawrence of the Atomic Energy Div, Babcock & Wilcox Company. Theory of operation was covered additionally.

At the February 6 meeting, Richard L. Miller spoke on the Greater Buffalo Development Foundation and Harry Broley discussed the Arthur D. Little Report on the proposed downtown plaza project and its implications.

**NEW YORK . . .** Automatic dampers are a vital part of most heating, ventilating and air conditioning systems. However, because they are relatively simple, they have received far less engineering attention than other equipment. February speaker H. W. Alyea of Johnson Service Company reviewed flow characteristics and normal leakage factors of both parallel and opposed blade types of dampers. Fan and system characteristics, as they affect and are affected by the operation of such dampers, were discussed and the importance of correct damper sizing was emphasized.

Subject of the second of the Spring Series of Technical Seminars were "Air Filters." Methods of testing and rating and design, application and selection were covered by Dr. Preston McNall of Minneapolis-Honeywell Regulator Company and James W. May of American Air Filter Company.

**EVANSVILLE . . .** February speaker was H. Chamberlain of Minneapolis-Honeywell Regulator Company. Covered were several points in residential electronic air cleaning, such as particle sizes, viscous-impingement type filters, application, installation and field service.

**who's doing what . . .** New members of the Nominating Committee are: R. E. Deaux, Frank Thomas, A. K. Mieg, R. W. Bond and J. L. Hochmeister.

**MONTREAL . . .** "Legal Responsibilities of a Contract By the Consulting Engineer, the Contractor and the Equipment Supplier" were covered at the January 16 meeting by William Tetley of Walker, Chauvin, Walker, Allison & Beaulieu.

**NEW MEXICO . . .** George Sebree of Sebree Equipment Company spoke on pumps at the January 17 meeting, with emphasis on proper selection and application.

**who's doing what . . .** Carl Sweikhart has been named Chairman of the Fund Raising Committee and William Blackwell is new Chairman of the Publicity Committee. Vernon J. Stephens is Chapter delegate to the Regional Meeting, to be held in El Paso, April 24.

**SACRAMENTO VALLEY . . .** Using slides detailing operating principles, Harold H. Yackey, Jr., of Carrier Corporation, spoke at the February 1 meeting on design of absorption air conditioning systems.

**AUSTIN . . .** Meeting January 19, a panel comprised of J. Boyer, Moderator; C. A. Schutze, Jr., legal and insurance expert; T. Brown, State Highway Department; and W. T. Cortelyou, Fidelity and Deposit Company of Maryland, discussed "Legal and Bonding Procedures in the Construction Industry."

**who's doing what . . .** James Purdy, Chapter Regional Delegate, has moved to Dallas; Frank Gerling



has been appointed to succeed him. Pike Dobbins has been appointed Chairman of the Fund Raising Committee for the United Engineering Center.

**PHILADELPHIA . . .** Milton I. Allen, Vice President—Sales of Philadelphia Electric Company, speaking on "Weather by Wire" at the February 9 meeting, stated that it is his contention that people will be buying electric home heating in increasing quantities even though costs may be higher. Reasons given for this were the clean heat and economical individual room control provided.

At the pre-dinner educational session, R. G. Barager of Dunham-Bush, Inc., spoke on "Control of Head Pressure on Air-Cooled Condensers in Wintertime Operation."

**PUGET SOUND . . .** Heating and ventilating aspects in design and construction of the Plutonium Recycle Test Reactor at Hanford were covered by February speaker R. M. Fryer. Dr. Fryer used slides to illustrate his talk.

**who's doing what . . .** N. W. Nelsen is Chairman of the Fund Raising Committee for the local UEC Building Fund Drive.

**NIAGARA PENINSULA . . .** Meeting jointly with Ontario Chapter, members of this Chapter toured the Nuclear Reactor Building of McMaster University on February 6.

**OREGON STATE COLLEGE . . .** Speakers for the evening of January 19 were Wayne Gibson of Peerless Pacific Company and Murray Gradin of Typhoon Air Conditioning Div, Hupp Corporation. Under discussion were "Reversed Cycle Heat Pumps".

**TUCSON . . .** Dr. Will Rogers of the University of Arizona Mechanical Engineering Department spoke on "Sound and Noise Measurements" at the February 7 meeting.

**who's doing what . . .** D. D. Shipley is this Chapter's Delegate to the Region X Meeting to be held in Phoenix, April 28 and 29; S. R. Palmer is Alternate. R. E. Joachim reported that this group has attained 58% of its goal in the UEC Building Fund Drive.

**UTAH . . .** Members of a panel which met on January 20 were Lee Irvine (Moderator), Hugh Folsom, Earl Gritton, Raoul Evans and Wayne Redd. Prepared questions were presented to the panel for discussion. Asked were: "How can engineers' specifications improve relations?" and "What salesmen's services can be improved or initiated?", together with similar questions.

**who's doing what . . .** Earl Gritton reported on the local UEC Building Fund Drive.

**LOUISVILLE . . .** Reviewing the operation of an absorption refrigeration system, as applied to air conditioning, January speaker Richard M. Merrick of the Bryant Div of Carrier Corporation compared each step to a compression system. Equipment of this nature uses either water absorbed in a salt such as lithium bromide or ammonia absorbed in water. Carrier utilizes the latter.

Installation costs were cited as being higher than for an equivalent electrical model, but operating costs are equal when 100,000 Btu of gas cost three times as much as one kw-hr of electricity.

Third Technical Seminar program was held January 18 at the University of Louisville, with Professor Albert Barnes of Speed School presenting some concepts on the use of models in engineering work. The performance of a model can be related to the prototype by the laws of similitude and dimensional analysis. Purposes cited for use of models include determination of: appearance, flow patterns, pressure distribution, flow capacity, efficiencies, shear and pressure drag, operating characteristics, design improvement and cost reductions. Professor Barnes presented some of the basic similitude relationships and illustrated their use by an example relating the performance of a large earth-mover to a small scale-model of similar configuration.

**SOUTHERN CALIFORNIA . . .** An appraisal of the current situation with regard to engineers entering the heating, air conditioning and refrigerating field was made by February speaker Harold P. Hayes, Dean of California State Polytechnic College. He



Conversing at the February 20 meeting are Harold P. Hayes, Dean of California State Polytechnic College, Guy King of Santa Monica City College and Chapter President William L. Holladay.

asked, rhetorically, what graduate schools are furnishing men to this industry and what non-profit foundations have been built from its successes. It is his contention that much progress in this field has been claimed by the aircraft or electronic industries, and he urged greater encouragement of research.

**who's doing what . . .** A. Z. Levine, Kenneth N. Robertson, Mary Wong, Kenneth D. Simon and Philip R. Kilgore have been elected to the Nominating Committee. Sterling W. Horton is ASHRAE Representative to the Educational and Vocational Guidance Committee of the Los Angeles Technical Societies Council.

**SAN JOAQUIN . . .** First of two speakers at the February 21 meeting was L. G. Ledblue of Sanger Ice and Cold Storage Plant. He traced the history of the plant from 1942, when it was operated as an ice manufacturing plant, through the Second World War, when it was converted to a quick freeze installation for freezing beef for the Army, and after the War, when it was again converted for quick freezing of fruit and vegetables.

Stewart Smith, Chief Engineer for the plant,

detailed the operation of the refrigeration, quick freeze and cold storage sections. Using ammonia as a refrigerant, the plant is capable of maintaining temperatures from -40 F to normal cold storage temperatures of zero F. Several types of equipment are used, including high speed direct-driven, rotary-type and horizontal single-cylinder compressors. Total tonnage for the plant is approximately 1000.

After the two discussions, members were conducted on a tour of the plant facilities, which included the main storage rooms, freezing tunnels and the auxiliary ice plant, where ice is manufactured for commercial purposes.

**who's doing what** . . . Past President John Lamborn was presented with a plaque in recognition of his work for the Chapter.

**SOUTH PIEDMONT** . . . At the January meeting a fan performance demonstration was presented by W. E. Tracey of Westinghouse Electric Corporation.

**who's doing what** . . . Neal McGuire was recognized for his service as President of the Chapter last year by presentation of a Certificate of Appreciation, gavel and Past President's Pin.

**WICHITA** . . . Jack Tracey, Manager of the Wichita Branch of Minneapolis-Honeywell Regulator Company, was guest speaker at the February 20 meeting. Speaking on "Electronic Air Filters," he used a working model to demonstrate his points.

**NORTH ALABAMA** . . . Limiting his discussion of heat pumps primarily to larger commercial and industrial building applications, January speaker James A. Evans concluded that air is the most practical heat source and sink; water is the most practical fluid for heating and cooling distribution; reciprocating compressors in multiple units are best on applications from 50 to 300 ton; and that heat pumps can be economical where properly applied.

**who's doing what** . . . W. L. Wayman, Alternate to the Regional Meeting in Kansas City, reported on proceedings at the gathering.

"School House Air Conditioning" was the topic of February speaker Maurice J. Wilson of Carrier Corporation.

**BATON ROUGE** . . . E. Bruce Appling of York Corporation spoke at the January 18 meeting on the "Three Pipe Air Conditioning System". Questions from the membership covered design considerations and other points of special interest.

**who's doing what** . . . James Graves has begun contacting members for the UEC Building Fund Drive.

"How the Mechanical Industry Has Changed in the Last Ten Years and How It Can be Improved" was the subject of a panel discussion at the February 22 meeting.

**who's doing what** . . . Roy Thibodaux reported on the Annual Meeting in Chicago and on the accompanying Exhibition.

**BOSTON** . . . Speaker at the February 21 meeting was Chapter Vice President A. L. Hesselschwerdt, Jr., who discussed "Refrigeration in the Process

Industries." He dealt with theory of design and use of existing equipment under new evaporation conditions. Charts and graphs illustrated the theory.

**ONTARIO** . . . Steam traps were discussed at the January meeting by Albert Milne, Vice President of Sarco, Inc. Many traps appear to be in working condition prior to use, but malfunction when operating, contended the speaker. Mr. Milne's point was that this often is due to conditions such as undersized pipe connections or operation of the steam trap beyond its capacity. By making installation improvements, rather than discarding the trap, many problems can be solved.

**who's doing what** . . . Proposed by the Nominating Committee for the position of President are J. Coates and E. Fox. Nominated for the Board of Governors are: M. K. Bowman, R. A. Brown, E. T. Coles, J. W. Coutts, F. H. Goddard, G. Granek, F. D. Ledgett, W. A. Mould, A. M. Norling, E. J. Okins, J. B. Parker, H. R. Roth, G. Toms and W. G. Woodcock.

**FLORIDA WEST COAST** . . . An illustrated discussion of the history and modern trends in the field of food preparation and preservation was presented at the January 17 meeting by Dr. J. G. Woodroof, ASHRAE Fellow and Region IV Director, Head of the Department of Food Processing, Georgia Experiment Station.

**HOUSTON** . . . Speakers at the January 20 meeting were Hamilton Brown, who discussed zoning, and Charles H. Kerner, Partner in the architectural firm of Golemon & Rolfe, who spoke on problems of the architect.

**who's doing what** . . . John Ames has been appointed Chairman of the local UEC Building Fund Committee. R. F. Taylor was Chapter Representative to the Annual Meeting in Chicago.

**WISCONSIN** . . . Program for the meeting of January 16 consisted of a panel discussion on "Job Specifications". Members of the panel were C. E. Melcher, Moderator; E. A. Latus, representing the owner; J. Rose, Architect; B. Fredericksen, Consulting Engineer; W. Holland, Consulting Engineer; E. Dzirbik, Contractor; and H. Schreiber, Manufacturer. Each panel member in turn answered the question "What type of specifications do you prefer and why?"

**who's doing what** . . . E. Zieve of the Membership Committee reported fifteen new members.

## CHAPTERS REGIONAL COMMITTEE MEETINGS AND CONFERENCES

REGION II, Quebec Chapter (Quebec), May 12  
(Meeting)  
REGION VIII, Shreveport Chapter (Shreveport), April  
21-22 (Conference)  
REGION IX, El Paso Chapter (El Paso), April 24  
(Meeting)  
REGION X, Central Arizona Chapter (Phoenix), April  
28-29 (Conference)



# Amendments to the BY-LAWS

*As read to the membership at the Annual Meeting in Vancouver, B. C., June 13-15, 1960, and voted upon affirmatively at the Semiannual Meeting in Chicago, February 13-16, 1961.*

*The numbered sections printed herewith supplant those originally provided as of January 29, 1959, and as amended previously by vote of June 1960. See ASHRAE JOURNAL, November 1960, page 71.*

Sec. 3.21 Membership in the Society and advancement in grade shall be in accord with the procedures and the conditions set forth below.

Sec. 3.22 All applications for admission to the Society in all grades except Student grade and all applications for advancement in membership grade shall be referred to the Admissions and Advancement Committee for investigation and report to the Board of Directors with recommendation as to grade. As soon as practicable after the report, the Board of Directors shall act upon each application by letter ballot. Two (2) disapprovals shall reject any applicant. One (1) disapproval shall require the resubmission of the application to the Admissions and Advancement Committee for further study and it shall make recommendation to the Board of Directors and the Board of Directors shall vote upon the application at its next regular meeting.

Sec. 3.23 Application for admission to the Society in the Student grade of membership properly endorsed by a member of the engineering faculty of the degree-granting or graduate school stipulated in Section 3.9 shall be referred to the Admissions and Advancement Committee for acceptance. Upon approval of the application by the Admissions and Advancement Committee, the Executive Secretary shall be empowered to issue Student memberships to the approved applicants.

Sec. 3.24 Renumber as Section 3.25.

Sec. 3.25 Renumber as Section 3.24 and revise as follows: Before submission to the Admissions and Advancement Committee of an application for election as, or advancement to, Affiliate, Associate Member or Member, the name of the applicant shall be published in an issue of the Society's official journal.

Sec. 3.26 Nominations for Fellow shall be made by the Honors and Awards Committee to the Board of Directors or by petition of not less than ten (10) Fellows and Members. Election shall be by the Board of Directors by secret ballot and more than two (2) negative votes shall defeat the proposal.

Sec. 3.27 NEW.

Nominations for Honorary Member shall be made by the Honors and Awards Committee to the Board of Directors. Election shall be by the Board of Directors upon unanimous vote by secret ballot.

Sec. 8.3 The Board of Directors shall prescribe the qualifications of members of committees and the number of committees. It may in addition, unless otherwise provided, adopt rules specifying the size of committees, the length of term members may serve, when members may be reappointed, selection procedure, and approval of appointments.

Sec. 8.8.2 The Finance Committee shall consist of five (5) Members including the Treasurer, one Vice President and three (3) others, each of these three (3) to serve a term of three (3) years. The President shall appoint one of these last three (3) committeemen each year, shall select the Vice President who is to serve, and shall fill any vacancies. One of three-year appointees shall be a member of the Board of Directors.

Sec. 8.8.18 The Nominating Committee shall consist of eighteen (18) members, each of whom shall hold the grade of Member, Fellow, or Life Member in the Society and shall have been a full Member in good standing in the Society for a period of at least five (5) years at their selection as follows: One (1) member with one (1) alternate from each region of the Society selected by the Chapters Regional Committees; six (6) members with six (6) alternates selected by the Board of Directors of whom two (2) members shall represent each of the three (3) major areas of

membership interest, namely, (1) heating, (2) refrigeration, (3) air conditioning and ventilation; one (1) member selected by the President from the last prior Nominating Committee, and the last preceding Past President who will not be a member of the Board of Directors during the year of service of the committee, and who agrees to serve, shall be its Chairman and shall have the right to vote.

The Nominating Committee shall serve during the Society year, except that the term of service shall begin with the opening of the Annual Meeting. Members and alternates shall be selected during the Society year preceding their year of service, as follows: Regional selectees by the Chapter Regional Committees at their regular called meetings, Board of Director selectees by the Board at their Semi-Annual meeting, and the presidential selectee, by the President of the Society at the time of the Society's Semi-Annual Meeting, with all selections becoming effective on the opening day of the Annual Meeting.

There shall be no more than one (1) member and one (1) alternate from any one (1) Chapter, no more than three (3) members and three (3) alternates from any one (1) Region on the Nominating Committee. No member of the Board of Directors shall be eligible to serve on the Nominating Committee.

Nominations of officers and members of the Board of Directors, other than those nominated by the Nominating Committee, may be made in writing by not less than fifty (50) members eligible to vote, upon presentation of such nominations, with each nominee's consent, to the Executive Secretary at least sixty (60) days prior to the first session of the Annual Meeting, whereupon the nominees' names shall be placed upon the ballot with a notation that they are presented by members independent of the Nominating Committee.

Sec. 8.8.22 The Public Relations Committee shall conceive and direct a program of public relations to make fully known and easily understood the aims, activities and achievements of the Society as well as its scientific and educational purposes with the object of cultivating and stimulating the interest of members, other professional people and the general public in the Society and its affairs.

Sec. 8.8.23 The Research and Technical Committee, subject to the direction of the Board of Directors, shall conduct and coordinate basic research and technical studies in the fields of heating, refrigeration, and air conditioning and ventilation, subject to the proviso that these activities shall be devoted to the public welfare and general benefit, and shall not be designed to promote any individual, private, or commercial interests.

In addition to the research activities, this committee shall plan for and have charge of the activities of the technical committees appointed to further the advancement of the arts and sciences of heating, refrigeration, and air conditioning and ventilation, and the allied arts and sciences for the public benefit. It shall determine the scope of the activities of each of these technical committees.

The committee shall consist of twelve (12) members nominated by the Board of Directors, and elected by vote of the Board of Directors. Four (4) members shall be elected each year during the Semi-Annual Meeting of the Society to serve for a term of three (3) years commencing with the next Annual Meeting of the Society.

The Chairman, on the recommendation of the Committee, shall appoint such Technical Committees as may be deemed expedient to carry out the objectives of the Committee, or to advise it on specific projects.

# Nominations

## for election of officers and members of Board of Directors

The following nominations for officers and for ASHRAE Board of Directors have been made by a Nominating Committee as specified in the By-laws of the Society and Agreement for Consolidation. The Committee, whose Chairman is C. M. Ashley, and with representation by R. M. Westcott as a member of the last prior Nominating Committee, consisted of S. F. Gilman (Region I), Charles Torry (Region II), W. A. Siegfried (Region III), R. K. Rouse (Region IV), L. C. Burkes (Region V), D. S. Falk, (Region VI), D. M. Mills (Region VII), F. R. Denham (Region VIII), J. K. James (Region IX) and C. L. Hall (Region X), and these selections by the Board of Directors: R. A. Baker, J. R. Caulk, Jr., H. G. S. Murray, N. P. Vinther, R. A. Sherman and B. W. Farnes.

### FOR FIRST VICE PRESIDENT, JUNE 1961 – JUNE 1962: JOHN H. FOX

Vice President of Honeywell Controls, Ltd., the Vice Presidential nominee has been a member of the Society since 1935, when he joined precedent ASHVE. Treasurer of ASHAE in 1958, he served on the Council from 1951-56 and was Regional Director of Region VII in 1956. Affiliated with Ontario Chapter, he was a member of the Board of Governors from 1938-39 and 1946-48, Vice President in 1949 and President in 1950.

National activities in the former ASHAE have included membership on the following committees: Chapter Delegates, 1949; Chapters Conference, 1950 and 1952; Chapter Relations, 1950 and 1955; Membership, 1954; Special Committee to Codify Council Policies, Chair-



man, 1954-55; and Public Relations, Chairman, 1955-56. In 1958 Mr. Fox served as a member of the Executive Committee of ASHAE Council and as *ex officio* member of the Finance Committee.

Since the merger, he has been 1st and 2nd Treasurer, Chairman of the Finance Committee and a member of the Heating Section of the Divisional Advisory Committee. Currently serving as 2nd Vice President, he is also a Director-at-Large for the term ending June 1961, a member of the Honors and Awards Committee and Chairman of the Divisional Advisory, Regions Central and Committee Expense Review Committees.

### FOR SECOND VICE PRESIDENT, JUNE 1961 – JUNE 1962: FRANK H. FAUST

Manager of Product Planning, Marketing Research Service, for General Electric Company, he joined precedent ASHVE in 1930 and ASRE in 1935. Instrumental in organization of the North Jersey Chapter of ASHVE, he was Chairman of the Steering Committee for the Charter Organization, first President of the Chapter from 1953-54 and a member of the Board of Governors, 1953-55. A contributor to the ASHAE GUIDE, he was Associate Editor, Section VIII of the Applications Volume, ASRE DATA BOOK, and Editor-in-Chief of the 1951 edition of the Handbook of Oil Burning.

Active nationally, the Vice Presidential nominee has served as a member of numerous committees, among them: Joint Committee on Revision of Code of Minimum Requirements, 1952-54; TACs on Heat Pumps and Thermal Circuits, 1953 (Vice Chairman of both); Chapters Conference, 1953-54; Research (Executive and Long-Range Planning Committees), 1953-55; Standards, 1955-57

(Member and Chairman); Council, 1958; Regions Central, 1958; Publication Advisory, 1958; and Finance, 1958. He served a term as Regional Director of Region I and was first Chairman of the ASHAE-ASRE Joint Committee on Cooperation. As a member of ASRE, he served a three-year term on Council.

Following the merger, he has been a member of the Board of Directors, Divisional Advisory Committee and Committee on Standards for Comfort Air Conditioning. He is currently Chairman of the Chapter and By-Laws Committee, a member of the Long-Range Planning and Regions central (*ex officio*) Committees.



Elections will be made by ballots counted at the 68th Annual Meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers in Denver, Colo., June 26-28.



## FOR TREASURER, JUNE 1961 – JUNE 1962: JOHN E. DUBE

President of Alco Valve Company, with which he has been associated for more than 20 years, he is a graduate of the University of Cincinnati. Numerous papers and articles written by him have appeared in various technical publications and been read before local chapter meetings.

Joining the former ASRE in 1940, the Treasurer-nominee has participated as a Director of Council, 1958-59, and served on the Industrial Relations (Chairman), International Affairs and Research Exhibits Committees; and as Regional Director (IX), 1955-58.

ASHRAE activities since the merger include membership on the Board of Directors, Exposition, International Relations, Finance (current Chairman), Research Fund Raising (past-Chairman) and Advertising (*ex officio* member) Committees. He currently is serving a term (from February to June 1961) as Treasurer, having succeeded himself to that post, following the term from June 1960 to January 1961, and is a member of the Executive Committee. His local affiliation is with the St. Louis Chapter, of which he is past-Chairman and with which he has been active variously.



## FOR DIRECTORS:

### REGION VII

JUNE 1961 – JUNE 1962: BURT LOMAX, JR.

(To complete the unexpired term of J. E. Naylor, Jr., resigned)



Partner in the firm of Lomax, North and Associates, he established his own office as a consulting engineer in 1947; the current partnership was formed in 1956. He was elected to membership in 1948 and was Chairman of the Committee to form Mississippi Chapter of ASHVE in 1952, becoming first President of the Chapter in 1953 and a member of the Board of Governors in 1954. In 1959, he was made permanent Chapter Regional Conference Delegate.

### REGION I

JUNE 1961 – JUNE 1964: P. K. BARKER

Vice President and General Manager of Heat-X, Inc., he joined the former ASRE in 1946. Activities on the national level include membership on Standards Committees PR 24-57 (1956-57) and PS 30 (1957-59) and the Sites and Facilities Committee, 1954-58 (Chairman, 1956-58). From 1958 to 1960 he was Chairman of the ASHRAE Meetings Arrangements Committee, of which he is currently a member. He is also serving on the Exposition Committee.

Affiliated with Boston Section, he was Treasurer from 1946-47, Vice Chairman in 1947-48, Chairman in 1948-49 and Section Director from 1951-54.



### REGION II

JUNE 1961 – JUNE 1964: J. H. ROSS



President of John H. Ross & Associates, Ltd., he joined the former ASHAE in 1946 and has since served, on the local scene, as a member of the Board of Governors of Ontario Chapter (1950-53), Vice President in 1951 and President in 1952.

Nationally, he has been a member of the Chapters Conference and

Chapter Relations Committees in 1952 and an alternate on the Chapters Conference Committee in 1953; member of the TAC on Odors, 1954-56; and member and Chairman of Council and the Membership Committee (1956-58). In 1960 he was a member of the Membership Development Committee.

### REGION III

JUNE 1961 – JUNE 1964: E. K. WAGNER



Associated with the Power Regulator Company, his affiliation with Philadelphia Chapter included holding the offices of Secretary in 1947 and President in 1952.

National activities have consisted of membership on the Committee on Honors for Engineers, Chapters Conference, Chapters Regional, Nominating and Public Relations Committees, serving as Chairman of the last. Currently serving a term (from January 1960–June 1961) as Regional Director of Region III, he is also a member of the Meetings Arrangements Committee.

## FOR DIRECTORS AT LARGE:

JUNE 1961 – JUNE 1963: P. R. ACHENBACH



Designated a Fellow of the Society in February 1960, he was serving at that time as a member of the General and Administrative Coordinating Committee, Vice Chairman of the Admissions and Advancement Committee and Consultant to the Research and Technical Committee. Currently, he is a member of the GUIDE AND DATA BOOK Committee.

Active in both societies since his election to ASHAE in 1942 and to ASRE in 1947, he is past-President of the Washington Chapter, ASHAE, and past-Chairman of the Baltimore-Washington Section, ASRE. His participation in ASHAE affairs includes: Secretary, Chapters Conference Committee, and membership on the Nominating, Guide and Research Committees. In ASRE, he was a member of the Education and Standards Committees and Technical Committees TC 4.4, 1955-56 (Chairman) and TC 1-8, 1957-59.

(Continued on page 83)

# ASHRAE OFFICERS, DIRECTORS, COMMITTEEMEN

## OFFICERS

**President**  
R. H. Tull  
**First Vice President**  
J. Everetts, Jr.  
**Second Vice President**  
John H. Fox  
**Treasurer**  
John E. Dube  
**Executive Secretary**  
R. C. Cross  
**Executive Secretary Emeritus**  
M. C. Turpin

## BOARD OF DIRECTORS

**Past Presidents**  
Walter A. Grant  
D. D. Wile  
A. J. Hess  
Cecil Boling  
**January 1960—June 1961**  
N. B. Hutcheon  
Walter Heywood (I)  
Donald Angus (II)  
E. K. Wagner (III)  
**January 1960—June 1962**  
John Chandler  
George Linakie  
J. G. Woodroof (IV)  
James Downs (V)  
L. K. Warrick (VI)  
Fred Janssen (IX)  
**June 1960—June 1962**  
W. S. Harris  
W. L. McGrath  
J. W. May  
Axel Marin  
G. B. Rottman  
V. D. Wissmiller  
W. J. Collins, Jr. (VIII)  
T. J. White (X)  
**February 1961—June 1961**  
Burt Lomax, Jr.

## STAFF

**Technical Secretary**  
A. T. Boggs, III  
**Director of Research**  
B. H. Jennings  
**Assistant Secretary—Membership**  
F. W. Hofmann  
**Assistant Secretary—Public Relations and Fund Raising**  
J. H. Cansdale  
**Assistant Secretary—Meetings**  
Julia I. Szabo  
**Assistant to Treasurer**  
Martha Flaherty  
**Editor-Guide And Data Book**  
C. H. Flink  
**Editor-Journal**  
E. R. Searles

## GENERAL COMMITTEES

### EXECUTIVE

R. H. Tull, *Chairman*  
J. Everetts, Jr.  
John H. Fox  
John E. Dube  
Walter A. Grant  
D. D. Wile  
A. J. Hess  
Cecil Boling

### Members At Large

C. R. Fagerstrom  
C. B. Gamble  
P. N. Vinther

### DIVISIONAL ADVISORY

John H. Fox, *Chairman*

### EDUCATION

J. B. Chaddock, *Chairman*  
Merl Baker, *Vice Chairman*  
B. W. Farnes  
M. Kalischer  
R. G. Nevins  
J. H. Spence

### EXPOSITION

J. W. James, *Chairman*  
H. F. Spoehrer, *V. Chairman*  
P. K. Barker  
L. N. Hunter  
R. Luscombe  
D. Petrone  
P. J. Marschall, *ex-officio*

J. W. James, *ex-officio*  
**Meetings Chairmen**  
C. R. Gardner  
A. C. Martin  
H. L. Gragg  
V. J. Johnson  
Julia Szabo, *Secretary*

### FINANCE

John E. Dube, *Chairman*  
F. Y. Carter  
W. L. McGrath  
H. G. S. Murray  
R. H. Tull, *ex-officio*  
J. Everetts, Jr., *ex-officio*  
E. P. Palmatier, *ex-officio*

### Heating Section

John H. Fox  
W. S. Harris  
Axel Marin

### Refrigeration Section

J. W. Chandler  
W. L. McGrath  
V. D. Wissmiller

### ADVERTISING

F. Y. Carter, *Chairman*  
M. M. Herrick  
P. J. Marshall  
C. M. Wilson  
John E. Dube, *ex-officio*  
G. R. Munger, *ex-officio*

### Air Conditioning Section

G. A. Linakie  
J. W. May  
G. B. Rottman

### GUIDE AND DATA BOOK

P. B. Christensen, *Chairman*  
W. L. McGrath,  
*Vice Chairman*  
P. R. Achenbach  
F. H. Buzzard  
J. L. Ditzler  
W. H. Divine  
W. G. Hole  
C. F. Kayan  
M. W. Keyes  
P. J. Marshall  
S. P. Soling  
P. N. Vinther  
V. D. Wissmiller  
G. R. Munger, *ex-officio*

### MEMBERSHIP DEVELOPMENT

K. M. Newcum, *Chairman*  
G. W. F. Myers, *V. Chairman*  
W. L. Algie  
T. J. Crider  
Axel Marin  
H. P. Tinning

### RESEARCH FUND RAISING

A. Giannini, *Chairman*  
S. F. Gilman  
H. G. S. Murray  
R. A. Sherman  
R. G. Werden

### REGIONS CENTRAL

John H. Fox, *Chairman*  
**Regional Directors**  
F. H. Faust, *ex-officio*

### CHAPTERS REGIONAL

**Regional Directors**  
**Delegate and Alternate**  
for each chapter

### HONORS and AWARDS

W. L. Holladay, *Chairman*  
A. J. Hess, *Vice Chairman*  
L. Buehler, Jr.  
J. H. Fox  
A. C. Gowdy  
W. R. Woolrich

### NOMINATING—1960-1961

C. M. Ashley, *Chairman*  
R. A. Baker  
L. C. Burkes  
J. R. Caulk, Jr.  
F. R. Denham  
D. S. Falk  
B. W. Farnes  
S. F. Gilman  
C. L. Hall  
J. K. James  
D. M. Mills  
H. G. S. Murray  
R. K. Rouse  
R. A. Sherman  
W. A. Siegfried  
Charles Torry  
P. N. Vinther  
R. M. Westcott

### GENERAL and ADMINISTRATIVE COORDINATING

John H. Fox, *Chairman*  
F. H. Buzzard  
G. J. Finck  
J. B. Chaddock  
Merl Baker  
W. L. Holladay  
A. J. Hess  
P. J. Marshall  
C. L. Hall  
K. M. Newcum  
G. W. F. Myers  
C. M. Ashley  
L. Buehler, Jr.  
R. Werden  
V. D. Wissmiller

### LONG RANGE PLANNING

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P. B. Gordon  
E. R. Queer  
S. J. Williams

### INTERNATIONAL RELATIONS

R. C. Jordan, *Chairman*  
C. F. Kayan, *Vice Chairman*  
L. Amman  
A. J. Dangoia  
J. Galazzi  
H. Parli  
A. Rebel  
A. Silvera  
Zurich correspondent,  
*ex-officio*  
Panama correspondent,  
*ex-officio*

### PROFESSIONAL DEVELOPMENT

C. M. Ashley, *Chairman*  
L. Buehler, Jr., *Vice Chairman*  
C. S. Field  
W. Harris  
G. B. Rottman  
J. G. Woodroof

### TECHNICAL COORDINATING

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Lincoln Bouillon  
P. B. Christensen  
G. R. Munger  
W. P. Chapman  
W. L. McGrath  
E. P. Palmatier  
N. B. Hutcheon  
P. W. Wyckoff  
A. S. Decker

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G. J. Finck, *Vice Chairman*  
J. W. Chandler  
D. H. McCuaig  
W. J. Olvany  
M. C. Turpin

### MEETINGS ARRANGEMENTS

P. J. Marshall, *Chairman*  
C. L. Hall, *Vice Chairman*  
P. K. Barker  
G. W. F. Myers  
T. J. Phillips  
E. K. Wagner

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*Vice Chairman*  
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G. F. Carlson  
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W. Cooke, *Vice Chairman*  
Fred Janssen



C. W. Pollock  
R. G. Raney  
E. Von Arb  
J. A. McLean, Jr., *ex-officio*

RESEARCH EXHIBIT  
John A. McLean, *Chairman*

#### PUBLICATIONS

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W. P. Chapman,  
*Vice Chairman*  
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H. G. Gragg  
J. P. McDermott  
C. W. Phillips  
W. V. Richards  
L. K. Warrick  
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P. B. Christensen, *ex-officio*

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T. V. Johnson  
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A. G. Wilson  
E. R. Wolfert  
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J. Klassen  
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K. O. Schlentner  
J. Schreiner  
T. B. Simon  
S. P. Soling

#### SPECIAL COMMITTEES

##### UEC FUND RAISING

M. F. Blankin, *Chairman*  
W. J. Collins, Jr.,  
*Vice Chairman*  
T. E. Brewer  
J. E. Haines  
C. F. Holske

##### COMMITTEE EXPENSE REVIEW

John H. Fox, *Chairman*  
Cecil Boling  
W. L. McGrath  
John E. Dube, *ex-officio*

##### BUILDING

R. A. Sherman, *Chairman*  
T. B. Crider  
P. J. Marschall  
S. J. Williams, Jr.  
John E. Dube, *ex-officio*  
E. P. Palmatier, *ex-officio*

## NOMINATIONS

(Continued from page 81)

### JUNE 1961 – JUNE 1964: W. B. MORRISON



Consulting Engineer, Portland, Ore., he was elected to junior membership of precedent ASHVE in 1939, followed by advancement to full membership in 1947. In Chapter activities, he has served as a member of the Board of Governors, 1945 and 1948, Vice President in 1946 and President in 1947.

Nationally, he has been a member (1946 and 1953) and Secretary (1947) of the Chapter Relations Committee and Secretary (1949) and Alternate (1957 and 1959) of the Nominating Committee. He has authored several technical articles.

### JUNE 1961 – JUNE 1964: N. B. HUTCHEON

Assistant Director, Div of Building Research, National Research Council of Canada, he is the author of numerous technical articles which have appeared in various publications. An active member since joining the Society in 1950, he has served on the Committee on Research,

1953-59; TACs on Insulation (1953-58), Heating Load (1955-56), Heat Flow Through Glass (1953-55), Physiological Research (1956-58), Solar Energy Utilization (1956-59), and Combustion (1959); Guide Committee, 1955-58; Research and Technical Committee (current Vice Chairman) and Research Committee on Energy Conversion (Chairman, 1959). He is currently a member of the Technical Coordinating Committee and of the Board of Directors.



### JUNE 1961 – JUNE 1964: P. W. WYCKOFF



Chief Engineer and Director/Product of the Airtemp Div of Chrysler Corporation, he joined precedent ASRE in 1949 and ASHVE in 1955. He has authored several articles, published in Refrigerating Engineering, Air Conditioning & Refrigeration News and American Artisan.

Service on national committees includes membership on the ASRE Program Committee, 1956-57, and Chairmanship of the ASRE General Standards Committee, 1958, and ASHRAE Standards Committee, 1959-61. He is a member of the Technical Coordinating Committee.

## TIME-TEMPERATURE EXPERIENCE

(Continued from page 69)

ready two years old (equivalent of storage at 0 F for 2 years) the minute they first reached 0 F.

The importance of the complete integrated time-temperature curve in estimating quality loss is demonstrated again in curves B and C. Even though the time to reach 0 F was about 225 hr in each case, curve C caused over twice the quality loss experienced in

curve B. The primary reason for this large difference in quality loss is the time difference between the two curves in the higher temperature range where quality is lost at a most rapid rate. This example not only illustrates the importance of both time and temperature, but also shows the seriousness of these specific freezing practices in terms of quality loss. From this single example, it is evident that

products of less than optimum quality could still reach the consumer even if temperatures of 0 F or lower were maintained in all segments of the distribution system.

The ultimate quality of a product is determined by the care and control which is exercised in all phases of its growing, handling, processing, freezing and distribution. Exceptional care in one link of the overall frozen food chain certainly won't make up for weaknesses which may exist in other links.

# Candidates for ASHRAE Membership

Following is a list of 151 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by

advising the Executive Secretary on or before April 30, 1961, of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note: \* Advancement † Reinstatement

## REGION I

### Massachusetts

CARVOUNIS, T. L., Proj. Engr., Fred S. Dubin Assoc., Boston.  
PETERSON, W. N., Jr. Designer, Clevendon, Varney & Pike, Boston.  
SNOWDEN, T. E. JR., Htg. Vtg. & A-C Designer, R. G. Vanderweil, Cambridge.

### New Jersey

BEVANS, R. S., Mgr. Applied Mechanics Research, American-Standard, Union.  
KELLY, J. J., Director of Engrg., Hoke, Inc., Cresskill.  
KETZENBERG, G. N., Owner, Ketzenberg & Org, Inc., Avenel.  
NICHOLS, N. L., Sp4 E-4, Eqp. & Maint. Company, U. S. Army, Ft. Dix.  
RASHID, ABDUL, Proj. Engr., Esso Standard Oil Co., Bayonne.

### New York

BARTLETT, R. B., Proj. Engr., Voorhees Walker Smith Smith & Haines, New York.  
BELL, M. A.,\* Sales Engr., Associated Thermal Products, Inc., New York.  
GOLLON, ABE, Pres., Rimco Refrigerating Co., Richmond Hill.  
HENICK, ALFRED, Pres., Henick Control, Inc., New York.  
JACKSON, W. J., Eastern Advertising Rep., ASHRAE JOURNAL and GUIDE AND DATA BOOK, New York.  
JONES, W. A., Owner, J & K Plumbing & Heating Co., Inc., Binghamton.  
JORDAN, G. M., Sales Engr., C. W. Davis Supply Co., Syracuse.  
LYNCH, W. L. JR., Vice-Pres., Rome-Turney Radiator Co., Rome.  
MILLER, W. C., Cons. Engr., New York.  
MUNCH, A. E., Sales Engr., American Radiator & Standard Sanitary Corp., New York.  
NEWTON, D. A. JR., Sales Engr., Newton Engineering Co., New York.  
PROVENCER, J. A., Technician, Carrier Air Conditioning Co., Syracuse.  
STILLWELL, G. G., Sales Engr., Warren Webster & Co., Inc., New York.  
STRULSON, DONALD, Mgr. Plant Engrg. Dept., Remington Rand Div. Sperry Rand, New York.  
WHALE, W. E., Sales Engr., Vibration Mountings Inc., Corona.

### Rhode Island

BAIN, L. J., Mech. Engr., Fenton G. Keyes Assoc., Providence.

## REGION II

### Canada

BLADES, W. R., Repr., Douglas Engineering Co., Toronto, Ont.  
COUTURE, ALBERT,† Charge Appl. Engrg. Dept., Frigidaire Products of Canada Ltd., Montreal, Que.  
HAGEDORN, C. L., Vice-Pres., Gen. Mgr., Wade In Canada Plumbing Specialties Ltd., Toronto, Ont.  
LANGSNER, L. L.,\* Pres., Langsner-Fuhrer Inc., Montreal, Que.  
LEDoux, J. P., Sales Engr., Sheldons Engineering Ltd., Montreal, Que.  
LEGARE, R. G.,\* Sales Engr., Honeywell Ctls., Ottawa, Ont.  
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CRUM, J. E., Purdue University, Lafayette, Ind.  
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## ASHRAE PASSES \$36,000 MARK; \$2

## Your Chapter's Score as of March 10, 1961

At last JOURNAL report (March 1961), ASHRAE had contributed \$32,060.64 towards the United Engineering Center building fund. Our pledge is \$250,000. As of March 10, we had raised \$36,088.29—a gain of \$4,027.65 in one month. This is, by far, the largest amount yet contributed for a single month and reflects the revitalized efforts of our members.

However, our Society still has \$213,911.71 to go. Currently, 67 of our 88 chapters are conducting fund raising campaigns. Three of these chapters—Central Oklahoma, South Piedmont and Toledo—have achieved their quotas. Twenty-one chapters have not yet reported on their campaign activities and 11 chapters have not made any contributions.

This tabulation reveals the progress made by each chapter and lists the names of campaign chairmen. If your chapter has not yet organized a drive to raise its quota for the UEC fund, please call your local officers and offer your help. The other societies, who will share quarters with us in the new Center, have either raised their quotas or are very close to their goals. ONLY ASHRAE lags very badly behind.

Continue to support the ASHRAE-UEC campaign in your chapter. Contact other members and, most important, SEND IN YOUR PLEDGE TODAY!

Region	Chapter	Chairman	Members	Quota	Contrib.	To Date
I	Long Island	I. B. Miller	162	\$ 2,445	8	\$ 280
	New York	H. S. Johnson	707	10,605	36	1,730
	North Jersey	C. H. Smith	511	7,665	85	1,837
	Northeastern N. Y.	R. D. Marshall	120	1,800	5	100
	Boston	R. E. Reid	393	5,895	11	338.50
	Central N. Y.	J. P. Stewart	267	4,005	10	203.50
	Niagara Frontier	W. J. Bryan	186	2,790	5	255
	Northern Conn.	C. T. Cavanaugh	137	2,055	3	340
	Rhode Island	C. H. Dow	99	1,485	2	640
	Rochester	L. C. Englehart & S. J. Stachelek	116	1,740	0	0
	Southern Conn.	B. M. Pachtor	174	2,610	2	110
	Western Mass.		81	1,215	5	631
	TOTAL		2953	\$44,310	172	\$6,465.00
II	Quebec	J. P. Boulay	48	\$ 720	1	\$ 105
	Manitoba	N. B. Jorgenson	64	960	2	70
	Montreal		331	4,965	6	231.75
	Niagara Peninsula		87	1,305	1	10
	Northern Alberta	R. A. Williams	60	900	0	0
	Ottawa Valley	I. M. Paterson	98	1,470	9	115
	Southern Alberta		61	915	1	20
	Ontario	L. Algie	576	8,640	3	250
	TOTAL		1325	\$19,775	23	\$ 801.75
III	Baltimore		319	\$ 4,785	11	\$ 750
	Central Penn.		124	1,860	5	114
	Johnstown	Sigmond Moroh	90	1,350	11	276
	Nat'l. Capital	John Muirhead	247	3,785	13	260.80
	Philadelphia	C. J. Forve	646	9,690	52	1,482
	Pittsburgh	A. F. Nass, Jr.	245	3,675	17	544.50
	Richmond	F. J. Weiss	123	1,845	8	356.92
	Hampton-Roads		46	690	0	0
	TOTAL		1840	\$28,680	116	\$3,774.22
IV	Atlanta		202	\$ 3,030	3	\$ 80
	Fla. West Coast	F. C. Whitaker	91	1,365	2	15
	Jacksonville	Bruce Miller	106	1,590	0	0
	Savannah	M. J. Schuck	40	600	0	0
	South Florida	R. B. Galt	142	2,130	4	135
	North Piedmont	S. T. Oliver	114	1,710	3	70
	South Carolina	T. O. Curlee, Jr.	88	1,320	1	15
	South Piedmont	Neal McGuire	87	1,305	87	1,541 *
	TOTAL		870	\$13,050	100	\$1,856
*South Piedmont Chapter has exceeded its quota						
V	Cleveland	H. A. MacNair	374	\$ 5,610	38	\$ 854
	Columbus	William Taylor	234	3,510	51	676.50
	Toledo	C. B. Claspill & C. W. Stoneking	102	1,530	77	1,530 **
	Central Indiana	Ben Paller	206	3,090	7	245
	Cincinnati	Walter Rieger	241	3,615	21	655
	Dayton	N. O. Mitchell	193	2,895	8	100
	Evansville	R. E. Ahlf	125	1,875	4	60
	TOTAL		1475	\$22,125	206	\$4,120.50
**Toledo Chapter has achieved its quota						
VI	Illinois	D. A. Parkhurst	885	\$13,275	28	\$2,110
	Illinois-Iowa		102	1,530	8	370
	Iowa	Fred Miller	94	1,410	5	210.45
	Minnesota	H. B. Williams & J. A. Craig	448	6,720	53	1,448
	Wisconsin		326	4,890	6	160
	Central Michigan		122	1,830	4	130.20
	Michigan	W. M. Dull	519	7,785	10	151
	Western Michigan	D. A. Rackliffe	141	2,115	1	75
	TOTAL		2637	\$39,555	115	\$4,654.65



# ARK: \$250,000 GOAL STILL LONG WAY OFF

VII	Louisville		172	\$ 2,580	5	\$ 67.50
	New Orleans	J. T. Knight, Jr.	179	2,645	62	1,086.50
	Baton Rouge	J. O. Graves	54	810	3	40
	Kansas City	H. D. Betz	249	3,735	9	275
	Mobile	J. P. Scott	38	570	0	0
	North Alabama	G. R. Jackson	101	1,515	6	65
	Memphis	G. H. Avery	67	1,005	9	130
	Middle Tenn.	D. C. Orr	128	1,920	4	80
	Mississippi	C. M. Broad	49	735	4	60
	St. Louis		406	6,090	42	1,281.50
	TOTAL		1443	\$21,645	144	\$3,085.50
VIII	Alamo		63	\$ 945	1	\$ 25
	Austin	Pike Dobbins	55	825	0	0
	Houston	John Ames	204	3,060	4	40
	Shreveport	W. L. Jarvis	54	810	1	20
	Arkansas	Joe Miller	47	705	3	152.50
	Cent. Oklahoma	W. J. Collins, Jr.	116	1,740	78	2,200 ***
	Dallas		301	4,515	6	274.92
	Fort Worth		73	1,095	1	25
	Northeast. Okla.	John Nichols	69	1,035	1	288.15
	West Texas	R. L. Mason	45	675	2	30
	TOTAL		1027	\$15,405	97	\$3,056.57
***Central Oklahoma Chapter has exceeded its quota						
IX	El Paso		28	\$ 420	0	\$ 0
	Kansas Chapter/ Wichita Section		131	1,965	1	150
	Nebraska	C. H. Hurlburt	109	1,635	3	285
	Rocky Mountain	William Griggs	196	2,940	1	25
	Utah	E. V. Grittin	64	960	0	0
	New Mexico	R. B. Lee	82	1,230	7	474.55
	TOTAL		610	\$ 9,150	12	\$ 934.55
X	British Columbia	Don Monroe	170	\$ 2,550	0	\$ 0
	Inland Empire	R. O. Haneberg	75	1,125	2	15
	Oregon	Don Markman	228	3,420	3	120
	Puget Sound	B. A. Nelson	221	3,315	18	350
	Cent. Arizona	R. H. MacFarland	84	1,260	2	25
	Golden Gate	Hunter McLaughlin	352	5,280	52	884
	Sacramento Valley		95	1,425	2	40
	San Diego		69	1,035	5	84.13
	San Joaquin		44	660	0	0
	Southern Calif.	A. J. Hess	584	8,760	17	655
	Tucson	R. E. Joachim	59	885	20	591.15
	TOTAL		1981	\$29,715	121	\$2,764.28

For your convenience a contribution pledge form is incorporated within this page. Mail to ASHRAE, 234 Fifth Avenue, New York 1, N. Y.

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## ASHRAE Sound Measurement Standard Ready for Review

The Society Sound Standards Program is the result of recognizing that we cannot obtain proper sound control with respect to air conditioning systems unless we have adequate means for objective measurement of sound produced by this equipment. Both ASHAE and ASRE had initiated studies in the field of equipment noise prior to the merger. In 1955 ASHAE activated a sound study program at the Cleveland Laboratory. This initial program was to determine the techniques of sound power output of fans. A continuation of this original program included the study of sound generation and attenuation in duct systems. Results of this study were presented in a paper at the Semiannual Meeting in Dallas, February 1960.

In 1957 ASRE established a Standard Project Committee to prepare a standard for sound testing of equipment and invited ASHAE to participate in this standard on a joint basis. Prior to the merger and since the merger a number of preliminary drafts of a primary test have been completed.

The chairman of this project committee has indicated that the most recent draft of this standard has been approved by the project

A. T. BOGGS, III  
ASHRAE Technical Secretary

committee and a number of industry representatives who have reviewed the draft. Before going further, however, it is believed that the draft should receive a comprehensive review by all facets of industry interested in this subject. For this reason, review copies of the present draft will be sent to industry representatives requesting copies from the technical secretary.

In order that the project committee may obtain a consensus of industry at this stage of the development, review copies will be available for 60 days. As an indication of the scope of the proposed standard, the chairman of the project committee has stated that the purpose of the standard is to provide a realistic basis for the measurement of the sound output of air conditioning, refrigerating, and heating equipment. This standard does not establish recommended sound power levels for different types of equipment. It is expected that such requirements will be included in a trade association standard which is being developed.

**Standards Program** — At a recent meeting of the Standards Committee it was suggested that readers of the JOURNAL be asked to comment on the Society standards program. As a background for such comment, the available standards were listed on page 75 of the January JOURNAL and those standards being revised or developed were listed on page 74 of that issue. It is requested by the Standards Committee that any reader who is familiar with the existing standards and believes that any standard is not adequate or not necessary should contact the technical secretary. It would be helpful if those readers who have a special interest in the heating and ventilation area of the industry could comment on the desirability that ASHRAE develop testing standards in these areas.

When the need for a standard is brought to the attention of the Standards Committee the subject is investigated by a project committee and a standard is initiated. The membership of ASHRAE covers a great many types of industrial activities and the Standards Committee can recognize the need for standards only with the assistance of the membership.

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### MORE ECONOMICAL MEDIUM TEMPERATURE WATER

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(Continued from page 65)

terminal equipment must greatly broaden their lines of equipment capable of operating on small and even smaller water quantities.

#### CONCLUSION

Until engineers are able to translate the things suggested here into usable items we will have to improvise at the expense of economical design if we go higher than 275 deg (MTW) at the source of heat; except where pump hp exceeds  $\frac{1}{4}$  hp for source heat circuit

use for 325 deg (MTW). Of course, when process or other conversion needs require temperatures above 275 deg within the higher 325 deg system range, it becomes the logical choice.

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#### NOMINATING COMMITTEE

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(Continued from page 59)

just as it is for our business organizations.

For this reason, the Nominating Committee uses suitability for future officership of the Society as one of

the major criteria in the selection of Nominees for the Board of Directors, especially for Directors-at-Large. The Nominating Committee also gives considerable weight to effective service on Society committees and in other professional activities. Selections must also be kept in proper balance as to the major areas of technical interest and also between activity categories such as consulting, academic, manufacturing, distribution and servicing.

Out of these manifold requirements, your Nominating Committee selects the slate of nominees which it believes will best provide the vigorous leadership which the Society needs to keep it strong and to help it to fulfill its great promise and realize its opportunities.



The Diplomat, completed in 1959, offers a long list of unusual comforts and conveniences, embodying the finest in architectural design, construction, and appointments. Architect: A. H. Salkowitz; Engineer: Charles Wurmfield; Builder: Irving Warfield; Heating Contractor: Par Plumbing Company.

## LUXURY APARTMENTS SECURE YEAR-ROUND HEATING COMFORT WITH EASILY INSTALLED WEATHER-COMPENSATING SARCO THERM HEATING CONTROL SYSTEM

This is the Diplomat, a prestige address in Long Island's Forest Hills. Its Sarcotherm Weather-Compensating Heating Control System provides tenants with comfortable temperatures throughout the heating season, regardless of outside weather. In projects like this, perfection must extend to every area of living comfort, and Sarcotherm systems assure the necessary accuracy and reliability, *with no installation problems.*

Precisely calculated valve orifices, with plates brazed in at the factory, insure proper distribution of sub atmospheric steam, even in mild weather. Sarcotherm Continuous Flow Modulating Steam Control Valves, factory-calibrated, meter steam to provide proper heat by reacting not only to outside temperatures, but to changes in wind velocity and solar radiation. The complete programming operation is handled by a Master

Control Panel which automatically regulates cycles for daytime and nighttime operation and quick morning heat-up.

The Diplomat control system was easy to install rapidly, for several good reasons. Sarcotherm supplied custom-made detailed drawings, tagged every component, and keyed every part to the drawings. Sarcotherm engineers provided supervision throughout the job and made final system adjustment through start-up.

When you call in Sarcotherm on any major heating control problem, you get a custom-planned solution based on wide ranging experience. Sarcotherm takes undivided responsibility for quality components integrated into a reliable control system. It will pay you to deal with Sarcotherm. First step: Write for complete literature.

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# BULLETINS and CATALOGS

**Combustion Indicator.** A continuous reading instrument cited as accurately indicating changes in flame characteristics caused by variations in the air-gas mixture, the Qual-O-Rimeter is the subject of eight-page Bulletin Q-2. Typical uses illustrated include brazing and soldering, heating for hot working, setting up multiple air-gas machines and glass fiberizing; eleven other potential applications are outlined. Specifications and operation are detailed, including performance curves, a schematic diagram and an internal photograph.

**Selas Corporation of America,** Dresher, Pa.

**ARI Exposition.** Copies of the first promotional piece for the 12th Exposition of the Air-Conditioning and Refrigeration Industry (sponsored by the Air-Conditioning and Refrigeration Institute), to be held in Los Angeles February 12-15, 1962, are now available. Information on space rental is detailed.

**Air-Conditioning and Refrigeration Institute,** 1346 Connecticut Ave., N.W., Washington 6, D. C.

**Reference Charts.** Dividend Engineering, a new system for estimating thermal performance of buildings, is introduced in two twelve-page Bulletins, 4-GR-1754-A and 4-GC-1752-A, for roofs and walls, respectively. Utilized are data, compiled over a twenty-year period, on performance figures for many industrial and commercial buildings. This information has been converted into evaluation-analysis charts to identify insulation thicknesses in terms of savings in initial equipment and building operational costs. Factors considered include gas and coal, electricity, shading devices, climatic conditions, construction costs, depreciation and insurance.

**Owens-Corning Fiberglas Corporation,** 717 Fifth Ave., New York, N. Y.

**Blowers.** How Series 88 rotary positive displacement blowers provide constant metered quantities of gas or air, even against varying pressures, is discussed in twelve-page Bulletin S88-A. Operating principles are explained and advantages, such as low mechanical friction, insurance against gas contamination by lubricants and ability of the unit to be mounted in

several positions, are described. Dimensional charts and drawings illustrate dimensions of blowers with pipe plates alone and with pipe plates and gear box assembly. A full-page table gives maximum capacity and hp ratings for each of the six sizes in the series.

**Sutorbilt Corporation,** 2966 E. Victoria St., Compton, Calif.

**Manual Starter.** Designed for use with fractional hp motors, a new electric Class 10 starter, described in eight-page Bulletin 10-B1, provides manual, across-the-line, start-stop or off-on control of fractional and one-hp single-phase electric motors. Single and two-pole units include a built-in, trip-free thermal relay to protect the motor from sustained overload.

**Furnas Electric Company,** 1000 McKee St., Batavia, Ill.

**Industrial Heaters.** Extensive information on combination oil-gas industrial heaters is contained in twelve-page Bulletin OG-601-M12. Descriptions, technical data and application photographs of various styles are included. Blower performance charts are included for each of the units from 280,000 to 1,000,000 Btu/hr. Other tables provide dimensional data, air handling capacities, heat exchanger area, motor hp, additive cooling capacities and plumbing data. Diagrams show the various arrangements possible when auxiliary equipment is provided.

**Lennox Industries, Inc.,** 200 S. 12th Ave., Marshalltown, Iowa.

**Aluminum Curb.** Cited as assuring trouble-free installation of roof exhaust fans, this all-aluminum Thermal-Acoustic Curb is the subject of four-page Bulletin TA-101. Advantages are detailed and a cut-away diagram, illustration showing basic dimensions, dimension schedule, typical specifications and guarantee are included.

**Davidson Fan Company,** 213 California St., Newton 58, Mass.

**Water Treatment.** Selection of the proper type of water treatment equipment, for use at different boiler pressures and with different types of water, is the subject of a new article, Technical Reprint T-183. Designated "Water Treatment for High Makeup

Boilers Operating in the Range of 600 to 1250 lb.," the ten-page article covers four basic types of treatment, evaluating their use in typical plants with low, medium and high solids water. Case histories are discussed and new treatment and testing methods, including condensate scavenging, are reviewed. Tables, flow diagrams and photographs illustrate the article.

**Graver Water Conditioning Company,** 216 W. 14th St., New York 11, N. Y.

**Thermostat.** Available in single and double line break models, the Room Mate Thermostat is offered for use with this manufacturer's electric radiant cable heating systems and baseboard units. Range is from 35 to 90 F, with a differential of approximately 1 F. A flyer describes the product.

**Ceilheat, Inc.,** Knoxville, Tenn.

**Electric Heaters.** Wall heaters feature automatic temperature control, heating elements supported in rounded ceramic grooves and balanced heat output from a combination of direct radiation and circulation from electric chimneys. Several models are available.

Radiant heat with automatic temperature control is provided by a bathroom heater. Also available is a non-automatic model with manual on-off switch. Descriptive of Pacific heaters is four-page Bulletin AF24-05A.

**Wesix Electric Heater Company,** 390 First St., San Francisco 5, Calif.

**Driers, Filters, Strainers.** Four-page Bulletin D6 illustrates and describes an extensive line of flanged demountable shells with replaceable, interchangeable filter-drier, filter and strainer cartridges for permanent liquid line service on refrigeration and air conditioning systems. Shells include straight-through and angle types, single and dual lengths, in addition to manifolded sets mounted on wood panels.

Of all-brass construction, shells have heavy forged tongue and groove flanges and six bronze cap screws for easy servicing without breaking the line. Filter-drier cartridges have all-brass casings and offer choice of five desiccants. Shown in a selection chart are dimensions, water capacities, drying capacities and tonnage ratings on a wide range of sizes for 1 to 100-ton systems.

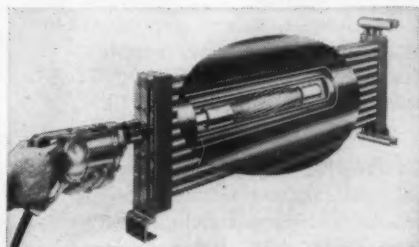
**McIntire Company,** Livingston, N. J.

**Calculator.** Designed to reduce calculations required by air duct and grille installations, this slide rule-type

"Here's why I always pick H & M water-cooled condensers

# ...you can clean them safely because you clean them mechanically!

"Time was when I used chemicals to clean out the scale and sludge in my water-cooled refrigeration systems. But soon I found out that the chemicals were doing damage not only to the condensers but the cooling tower and pump, too.



"Now I always buy Halstead & Mitchell Water-Cooled Condensers, because they can be cleaned safely

with a simple mechanical tool and an ordinary electric drill. The end plates remove easily to expose the water tubes."

Another good reason to choose H & M condensers: they give more liquid sub-cooling because of the double-tube design and true counterflow of refrigerant and water.

There are five different types, including models for sea water or poor water conditions, in capacities of  $\frac{1}{2}$  to 25 tons.

Call your parts wholesaler for more information, or write for Bulletin WC-300. Halstead & Mitchell Co., Dept. E-4, Bessemer Building, Pittsburgh 22, Pa.

Water-Cooled Condensers • Air Handlers and Coils • Cooling Towers • Air-Cooled Condensers



## Halstead & Mitchell





calculator is cited as giving accurate readings of friction, velocity in fpm, weight per lineal ft of round duct and surface area in sq ft per lineal ft of round duct. Computations are given also in terms of rectangular duct, as well as B & S gauge galvanized steel. Calculations are arrived at by either the equal-friction or velocity-reduction methods.

On the back of the calculator is a register and grille selector. Shown on the register selector are free area recommended face velocity, cfm, heating and cooling Btu/hr, throw and spread. Price is \$1.00.

**Lima Register Company, Lima, Ohio.**

**Air Conditioning Units.** Subject of a 20-page catalog is the Fedair Type F remote air conditioning line, consisting of free standing, recessed, overhead and recessed overhead models. **Fedders Corporation, Heating Div, Lalor & Hancock St., Trenton 7, N. J.**

**Control Valves.** Extensive engineering information on sliding gate and plate control valves is included in eight-page Catalog J170-1. Recommended for use on steam, water, air, oil, gas and chemicals, valves are available in sizes from 1/4 to six in.

Detailed in the bulletin are applications, operating features and characteristics, materials of construction and pressure and temperature limitations. Photographs and cut-sections, flow curve, sizing charts and sample specifications are included also. Controllers, positioners and other accessories are described.

**OPW-Jordan Corporation, 6013 Wiehe Rd., Cincinnati 13, Ohio.**

**Controlled Area Heating.** Flyer 10/OA and a four-page bulletin present detailed information on Infratube radiant heating. High radiant energy emitted from a fused quartz element is channeled to areas where heat is required by means of semi-parabolic reflectors, with special end reflectors to ensure wide area coverage. Tables indicate capacities and heat coverages of various models in the line.

**Apextro Products Company Div, Apex Sheet Metal Works, Inc., 1821 N. Eastlake Ave., Los Angeles 31, Calif.**

**Pipe Fitters' Manual.** Compiled in a 76-page booklet is much of the diversified information necessary to pipe fitters, in the sciences of mathematics, physics, chemistry and metallurgy, as well as related skills such as design, layout and mechanics. Much of the information is presented in tables, charts and graphs.

Partial table of contents listing in-

cludes: advantages of welded piping systems, wall thickness after threading, useful formulas, conversion factors, dimensions of welding fittings and flanges, drafting symbols, welding information; properties of pipe, metal and fluids; drill sizes, abbreviations and pipe fitters' definitions.

**Tube Turns Div, Chemetron Corporation, Louisville 1, Ky.**

**Instruments.** For installation, proof testing and maintenance of electrical equipment, instruments described in 12-page Catalog 10-1.3 include dielectric test sets ranging from heavy-duty types with ac or dc potentials to 150 kv through mobile, bench and hand-carried portable models. A line of testers for insulating materials and oils, as well as an arc resistance tester, are discussed, and megohmmeters with ranges to five million megohm are offered for installation and proof testing of equipment. Other instruments covered are corona detection and measurement equipment, portable kilovoltmeters, sphere gap assemblies and high voltage power supplies.

**Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill.**

**Air Heating Equipment.** For residential and commercial applications, air heating equipment detailed in eight-page Bulletin RC-101 includes automatic Ionix and radiant wall convectors, automatic forced air and portable heaters, perimeter drop-ins, baseboard panels and bathroom heaters. Specifications, illustrations, features and accessories are presented.

**Wesix Electric Heater Company, 390 First St., San Francisco 5, Calif.**

**Air Handler.** Descriptive of the new Thermal EC Air Handling Unit for small stores, restaurants, offices and apartments is a four-page bulletin. Extensive technical data are given on each of the five models. Units are available in three styles: the horizontal De Luxe, horizontal Standard and vertical Standard.

**Thermal Engineering Corporation, P. O. Box 13254, Houston 19, Texas.**

**Water Heaters.** Introduced in a flyer is a new line of Bantam electric water heaters in both round and square styles and 3, 6, 12 and 18-gal sizes. All units now combine anti-corrosive Nu-Clear glass-lined tanks and Dow Anode Magnesium Rods for protection with Heat-Belt elements for fast service. Elements are changeable without removing, disconnecting or disassembling the heater.

Offered on 18-gal water heaters is a three-way selector switch. Element

wattage may be changed, by this means, to 500, 1000 or 2000 watt to accommodate desired speed of recovery.

**Teter, Inc., 13901 S. Indiana Ave., Chicago 27, Ill.**

**Low Voltage Equipment.** Designed to serve as a condensed buying catalog for products of this company's Distribution Assemblies and Circuit Protective Devices Dept, the 92-page Buy-Log (GEC-1100C) provides extensive information on heavy-duty safety switches, CLF current-limiting fuses, hinged wireway, circuit breakers, switchboards, motor control centers, power distribution centers and many types of panelboards and busway. Among features of the catalog are product selector charts, descriptions, consolidated pricing tables and a catalog number index. Also detailed are ratings, weights, dimensions, standard package quantities and general application information.

**General Electric Company, Plainville, Connecticut.**

**Timing-Belt Drives.** For mechanical power transmission, drives are available for load capacities from fractional to 600 hp and for belt speeds to 16,000 fpm. To select a timing-belt drive, it is necessary to determine circular and belt pitch, drive width, pitch diam of driver and driven pulleys and belt pitch length. Information needed for selection is included in 80-page Catalog 19103.

Featured is a series of charts designed to provide graphical solutions in place of numerical calculations. One full-page chart enables selection of pitch from the factors of design hp and speed of the pulley of largest rpm. 27 pages of drive tables allow determination of driver pulley and belt pitch length when the speed ratio and driven pulley are known.

**T. B. Wood's Sons Company, Chambersburg, Pa.**

**Fan Installation.** Flyer AS-101 explains advantages of placing roof exhaust fan motors in the air flow. Illustrating this principle are a cut-away diagram and an installation photograph.

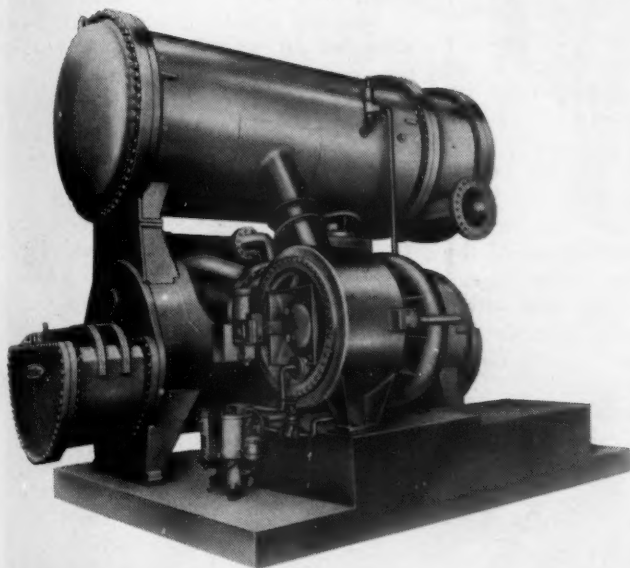
**Davidson Fan Company, 213 California St., Newton 58, Mass.**

**Capsular Motor Insulation.** Introduction of a new insulation system for encapsulated, random wound, ac induction motors is announced in Bulletin 3750. Offered is added protection against moisture, chemicals, oils and abrasive contaminants. Void-free, conventionally wound stators feature



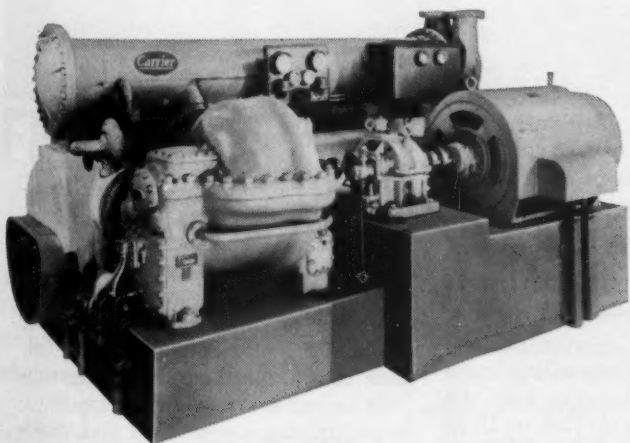
# CARRIER CENTRIFUGAL REFRIGERATION CAN BE USED WITH ANY TYPE OF DRIVE

*...electric motor, steam or gas turbine, diesel or gas engine!*



**Carrier Centrifugal—2000 to 5000 tons**

With barrel type compressor—can be used with electric motor, steam or gas turbine, diesel or gas engine drives.



**Carrier Centrifugal—100 to 2000 tons**

With horizontal split casing—can be used with electric motor, steam or gas turbine, diesel or gas engine drives.

The versatility of Carrier Centrifugal Refrigeration Machines is practically unlimited for air conditioning, process cooling or low-temperature refrigeration down to minus 185 F.

They are available in the industry's widest range of capacities—from 100 to 5000 tons.

They can be powered with any make or type of electric motor—variable or constant speed, a.c. or d.c., high or low voltage—or with a high or low pressure steam turbine, gas turbine, diesel or gas engine.

Though "custom-built," they also offer the economy of standard units. Carrier manufactures standard compressors, condensers and coolers in a number of sizes. That makes it economical to combine standard components matched to your client's needs.

Since the first Carrier machine, installed in 1922, more than 5000 Centrifugals all over the world have proven the day-in and day-out dependability of Carrier refrigeration. You can specify Carrier with confidence on any project. Write Carrier Air Conditioning Company, Syracuse 1, New York. In Canada: Carrier Air Conditioning Ltd., Toronto 14.

**Carrier** Air Conditioning Company

heat-resistant, plastics resin that seals end coils and fills spaces between wires in the stator slots with a moisture-proof, chemical-resistant, protective sheath. This insulation system can be supplied on open, drip-proof motors, 445U frame sizes and smaller, 600 volt and below, including special electrical and mechanical features.

**Louis Allis Company, 427 E. Stewart St., Milwaukee 1, Wisc.**

**Strainers.** More than 600 standard strainers for steam, air, gas and liquids are detailed in 12-page Catalog 6008. Shown is an extensive selection of available body materials, end connections, pressure ratings (150 to 2500 psi) and sizes ( $\frac{1}{8}$  to 10 in. in Y-type and 6 to 16 in. in start-up strainers). Pressure drop and pressure-temperature limit data are provided also.

**Leslie Co., 107 Delafield Ave., Lyndhurst, N. J.**

**Automatic Electric Defrost.** Option of ceiling installation in refrigerated storage rooms or use in walk-in coolers, where temperature of less than 34 F is to be maintained, is offered by the 18-model Hot-Shot line. Fully automatic and available in a standard range of capacities, from 700 through 6000 cfm, units may be used with ammonia or halogenated hydrocarbon refrigerants. Characteristics cited in Bulletins HS 842.02 and 844.01 include non-rusting aluminum housing, copper tube coils with aluminum fin for halo-carbon use and steel fin and tube on ammonia models. Additionally, heavy channel iron hangers are standard; four-blade, propeller-type fans are extra quiet; and 1050-rpm motors are oiled permanently.

**Drayer-Hanson Div, Hi-Press Air Conditioning of America, Inc., 3301 Medford St., Los Angeles 63, Calif.**

**Residential Air Conditioners.** Twin-line Models HA36, HA48 and HA72, the subject of four-page Bulletin RES 61-2401, provide two separate air conditioners in one package for whole-house air conditioning. Inside cooling coil is actually two coils, each joined to a compressor in the heat exhaust section. Installation may be on a concrete slab, atop a furnace or in an attic with the heat exhaust section outside.

Pathfinder Models, described in four-page Bulletin RES 61-2400, can be installed in an attic or crawl space or tied into forced warm air systems and are flush with the outside wall.

Presented in four-page Bulletin RES 61-2402 is the Champion Series,

which comes in two compact sections. Units are completely air-cooled.

**York Corporation, subsidiary of Borg-Warner Corporation, York, Pa.**

**Insulation Efficiency.** In report form, this four-page catalog shows a cost comparison on insulations used for an underground heat distribution system. Formulas illustrated in the booklet show that a small difference in insulation efficiency can result in a large heat loss and subsequent increases in heat cost.

**Ric-wiL, Inc., Barberton, Ohio.**

**Panel-Type Filter.** Text and illustrations in four-page Bulletin A1 describe advantages of this new filter, which is cited as providing longer service life than other throw-away types. Dynel, the material used in the filter, is a strong fiber with a highly irregular cross-section that stops and holds large quantities of dust. Performance graphs indicate characteristics of the filter fiber, a diagram shows typical arrangements for the standard system and a data table lists capacities and resistance for one and two-in. filters, which come in nine sizes.

**Union Carbide Development Company Div, Union Carbide Corporation, 270 Park Ave., New York 17, New York.**

**Glass Fiber Fabrics.** Listed in this bulletin are the most widely used constructions of glass fiber fabrics, woven rovings and tapes. Detailed specifications, prices, photographs of the production processes and detailed sketches of weave patterns are included.

**J. P. Stevens & Company, Inc., Broadway & 41st St., New York 36, N. Y.**

**Water Heater.** Fully automatic, this immersion-fired, large volume water heater is the subject of four-page Bulletin 5210-B. Range of sizes in the line has been reduced from 24 to 12 and several design changes have been made.

**Sellers Engineering Company, 4876 N. Clark St., Chicago 40, Ill.**

**Defrost System.** Incorporating automatic, time initiated-temperature defrosting, HC Heat Cycle Defrost Units are the subject of four-page Bulletin 5026. Included in the bulletin are schematic diagrams and extensive specifications.

**Dunham-Bush, Inc., 179 South St., West Hartford 10, Conn.**

**Acid Cleaner.** For use in cleaning scale deposits from boilers, heat exchangers, water lines, pumps and other equipment, this powdered acid

cleaner is a free-flowing mixture of a solid acid, corrosion inhibitor and antifoam. The active inhibitor is cited as making the cleaner safe for use in systems containing iron, steel, copper, copper alloys, brass and aluminum. Bulletin HSP-940, four pages.

**Hagan Chemicals & Controls, Inc., Hagan Ctr., Pittsburgh 30, Pa.**

**Infra-Red Heaters.** Residential and industrial heaters of two types are shown in a new catalog: Radiant Panel Heaters, using Pyrex glass panels and Radiant Tube Heaters, using Vycor tubes, which are resistant to thermal shock. Heaters may be mounted on wall or ceiling. Tube-type units are available in a portable model for use in construction work.

**Sun-Heat, Inc., a Div of Insto-Gas Corporation, 998 E. Woodbridge, Detroit 7, Mich.**

**Psychrometric Chart.** Designed for greater utility and accuracy in selection of air conditioning systems and equipment, this recently developed psychrometric chart is self-contained and provides information needed to solve most air conditioning problems without reference to auxiliary material. Advantages cited include: plotting may be done with any straight-edge; enthalpy values are read directly and require no correction; rectangular coordinates permit the slope of a line to be transferred easily from one point to another; constant relative humidity lines are included instead of percentage humidity.

**Trane Company, La Crosse, Wisc.**

**Water Heaters, Air Conditioning.** Three new manuals pertaining to the selection, installation and servicing of water heaters and air conditioning systems are now available.

"Domestic and Commercial Automatic Gas and Electric Water Heaters," a 24-page booklet, gives performance and specification data and sizing information. Under the heading "Sizing Guides" are given various examples of swimming pool heater, apartment, hotel and other high-volume uses of hot water. Among subjects covered are gas pressure regulation, piping, combustion and ventilation air, venting and service suggestions.

Outlined in "Air Conditioning Service Manual" are mechanical components of common air conditioning systems, wiring diagrams, a relative humidity chart and service procedures. Also detailed is the heating cycle.

"Air Conditioning Systems" shows how to calculate the U factor, sizing





## FREON-13<sup>®</sup> FOR LOW, LOW TEMPERATURES

Now available from refrigeration wholesalers to assure field servicing of your newest equipment

Expansion of a market can help create more business for everyone serving that market . . . manufacturers, wholesalers, contractors, servicemen.

Development of Du Pont Freon-13\* helped equipment manufacturers expand the market for mechanical refrigeration into the ultralow-temperature field. Now Du Pont has insured fast field servicing of ultralow-temperature systems by making "Freon-13" commercially available from a nationwide network of dependable wholesalers.

Two-stage cascade systems using "Freon-13" with

"Freon-12" or "Freon-22" can now create temperatures of -100°F. or lower. Commercial availability of "Freon-13" promises to extend many times the successful use of these systems for such applications as metal treating, shrink fitting of parts, oxygen manufacturing, environmental testing and low-temperature storage and preservation.

Du Pont works to expand your markets other ways, too — with marketing assistance to equipment manufacturers, technical assistance to service engineers, advertising support of the air conditioning and refrigeration industry.

\*FREON- and F- followed by numerals are Du Pont's registered trademarks for its fluorocarbon refrigerants.

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**FREON<sup>®</sup>**

PREMIUM QUALITY REFRIGERANTS



of heating and cooling equipment and suggestions for cooling operations. Included are charts, tables and formulas.

**Pioneer Manufacturing Company,** 3131 San Fernando Rd., Los Angeles 65, Calif.

**Flexible Tubing.** Designated "The Facts About Flexflyte," this bulletin describes construction and uses of a rugged flexible tubing used for ventilation, fume removal and materials handling systems. Included is a description of each of the seven types of Flexflyte, their characteristics, construction and standard sizes.

**Flexible Tubing Corporation,** Guilford 2, Conn.

**Electrically-Driven Fans.** Designed for compactness, Piggy-Bak fans are equipped with motors mounted on the fan housing. Motors are mounted on a bed plate with bolts, so that the motor bracket can be repositioned when the discharge is changed. Descriptive of this line, as well as belt-driven, direct drive and cast iron vent sets, is 16-page Catalog VS-200. Tabular information included covers fan size, hp and rpm ranges and cfm.

**Champion Blower & Forge Company,** Lancaster, Pa.

**Adjustable Speed Drives.** Outlined in six-page Bulletin 2900 is an extensive line of adjustable speed drives for applications in the  $\frac{3}{4}$  to 2500-hp drive range. Four types of packaged drives are described and details are given on available ratings, speed ranges, type of enclosures, associated controls and standard and special modifications.

**Louis Allis Company,** 427 E. Stewart St., Milwaukee 1, Wisc.

**Acid Cleaning.** Newly developed scale dissolution rates for sulfamic acid cleaners are presented in eight-page Bulletin A-15181, and a diagram sheet showing simple equipment cleaning hookups is provided in four-page Bulletin A-13387. Main advantages cited for use of sulfamic acid cleaners for in-place descaling of industrial equipment include efficiency, ease of handling and safety to personnel and equipment.

**E. I. duPont de Nemours & Company, Inc.,** Wilmington 98, Del.

**Industrial Pumps.** Information presented in Catalog Section 101 covers a comparison and discussion of the differences of this regenerative centrifugal turbine pump as opposed to a conventional centrifugal pump. Extensive selection, performance and

mechanical data, plus installation dimensions, are provided for three new end-mounted industrial pump designs.

Included are three basic construction variations, comparisons between end and center-mounted pumps and their characteristics. Under "Construction Data" five mechanical seals suitable for varied industrial applications are shown with their pressure limitations at various temperatures.

**Roy E. Roth Company,** Turbine Pump Div, Rock Island, Ill.

**Burners.** Series ZB nozzle-mixing, buried blast burners are described in four-page Bulletin H-42. Nine burner sizes are listed in a choice of 54 maximum firing capacities from 60,000 to 14,500,000 Btu/hr. ZB burners are designed for sealed or tight combustion chamber applications. Typical installation diagrams illustrate a wide range of possible applications. Selection and sizing information, including dimensions and specifications, permit ordering burners directly from the bulletin.

**Eclipse Fuel Engineering Company,** Rockford, Ill.

**Roof Ventilators.** Covering the L-CRF line of power roof ventilators, eight-page Bulletin DB3-200 provides data on dimensions, capacities, sound classifications and major features. Also described are accessories such as shutters, dampers, disconnect switch and receptacle, air relief vents and protective coatings.

**Ilg Electric Ventilating Company,** 2850 N. Pulaski Rd., Chicago 41, Ill.

**Regulators, Control Valves.** Descriptive of ductile iron regulators and control valves is four-page Bulletin J-DI. Sliding gate seats available in these units are illustrated, and the bulletin describes in detail the composition, properties and specifications of ductile iron valves. Also included is a comparison table on steel, cast iron and red brass vs. ductile iron.

**OPW-Jordan Corporation,** 6013 Wiehe Rd., Cincinnati 13, Ohio.

**Aluminum Grilles.** Described in six-page Bulletin GEN-2-60 is an extensive new line of all-extruded aluminum grilles. These grilles are manufactured with an etched finish, the result of a seven-stage process. Covered are circular, square, rectangular and half-round diffusers and accessories.

**General Air Products Corporation,** Stirling, N. J.

**Bathroom Heater.** Available in 120 or 240 volt with 800-watt capacity, the Quartzone Bathroom Heater is

described in eight-page Bulletin EC 199-R. Measurements of the unit are 24 in. long by 5 in. wide by 6 in. high. Tables cover capacity in Btu/hr, weight and type of controls.

**Electromode Div, Commercial Controls Corporation,** P. O. Box 1052, Rochester 3, N. Y.

**Sound Level Meter.** For use in control of equipment whose noise level must be kept at a minimum, this fully transistorized, battery operated sound level meter is discussed in four-page Bulletin 1400 E. Featured are accuracy, stability and sensitivity. Direct readings of sound pressure levels are given over the entire audio range from 24 to 140 db, on a large, easy to read, five-in. meter dial.

**Korfund Company, Inc.,** 53D Can-tiague Rd., Westbury, N. Y.

**Pipe, Flange and Fitting Data.** Information on pipes, flanges and fittings is provided by a ten-in. slide-rule type card. On one side are tables on pipe sizes, schedule number, wall thickness, weight per ft and pressure at yield on pipe from  $\frac{1}{8}$  to 24 in. On the reverse side are data on welded flanges and fittings: size (2 to 30 in.), dimensions and weight per piece. Also presented are data on cast iron and steel flanged fittings, sizes  $2\frac{1}{2}$  to 18 in.

**Albert Pipe Supply Company, Inc.,** 101 Varick Ave., Brooklyn 37, N. Y.

**Pump Motors.** Covered in four-page Bulletin 1455 are close coupled pump motors, both polyphase and single phase. Mechanical variations are detailed and standard keyed shafts, as well as the usual extended shafts, are included. Dimensions are provided for both close coupled and Pacific Coast pump motors.

**Century Electric Company,** 18th & Pine Sts., St. Louis 3, Mo.

**Flow Test Kits.** Four variable-area flowmeter kits, each containing meters of various sizes for a wide range of flow measurements, are discussed in four-page Bulletin 10A1010. Given are the contents of each kit, together with extensive data on performance, operational limits and capacities.

Two of the kits detailed are of the laboratory type — one uses hose connectors, the other standard taper joints. High capacity flowmeters are contained in the other two kits; one has rubber hose connections and clamps and the other is equipped with fully enclosed meters suited for pilot plant operations.

**Fischer & Porter Company,** 794 Jacksonville Rd., Warminster, Pa.

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SIGNS  
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**for contractors  
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Every contractor is eligible to join this owner-education program and be selected to receive an all-expense-paid vacation for two. Get complete information at once from your Marley Man or mail the coupon below.

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City \_\_\_\_\_

## PARTS AND PRODUCTS

### HUMIDITY TESTING

Humidity has been added to the Bench Model (SUB-Z-H) test chamber. Available in two, four and eight-cu ft sizes, the chamber has temperature ranges of -100 to 400 F and humidity range of 20 to 95%. Conditions are controlled by wet and dry bulb indicating controllers and an even temperature is accomplished by means of an eight-in. air circulator, with fin coil evaporator. Door may be hinged right or left and includes a 12 by 12-in. frost-free, multipane window. Optional features include terminals, ports and programming controllers.

Cincinnati Sub Zero Products, 3932 Reading Rd., Cincinnati 29, Ohio.

### AUTOMATIC TIMER

Useful for people who are absent from an apartment or small place of business during regular periods of time and desire to return to a comfortably cool environment, this automatic timer can program a full week's operation for a room air conditioner. Desired on and off times are set on the lower dial and days of operation



are chosen on the upper dial. Timers are available in 115 and 230-volt models.

Admiral Corporation, 3800 W. Cortland St., Chicago 47, Ill.

### REGULATORS

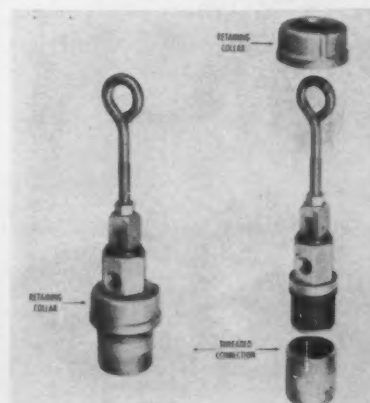
Four and six-in. sliding gate, air-operated, back pressure regulators are offered in capacities to 50,000 lb of steam per hr or 25,000 gpm of water. Sliding gate seats used in both the pilot and main valve give accurate regulation, tight shut-off and minimum maintenance, are self-cleaning and self-lapping, and provide close control. System is cited as being suitable for pressures to 250 psi wsp and temperatures to 500 F. Construction of the main valve is cast iron with 125-psi flanges or ductile iron with

150 or 300-psi flanges. The pilot is a standard screwed end control valve with special sliding gate seats.

OPW-Jordan Corporation, 6013 Wiehe Rd., Cincinnati 13, Ohio.

### CONNECTOR VALVE

Permitting fast, easy adaption of pressure lines to threaded connections of



tanks and other vessels requiring test pressures to 1000 psi, the Quick-Seal Filling Connector and Retaining Collar is of the expanding seal type, which utilizes the expansion of a flanged rubber bushing that fits loosely into the opening to be sealed.

Actuating the hand cam lever causes the bushing to expand against the side walls of the opening and the flange is drawn to seat and seal against the outside face of the fitting, thus effecting a leak-proof seal. The retaining collar bears on the filling connector and is threaded internally to screw onto the threaded connection of the vessel under test. Purpose of the collar is to provide additional holding power for the connector during admission and holding of high test pressures. Unit is available for use on pipe sizes to four in.

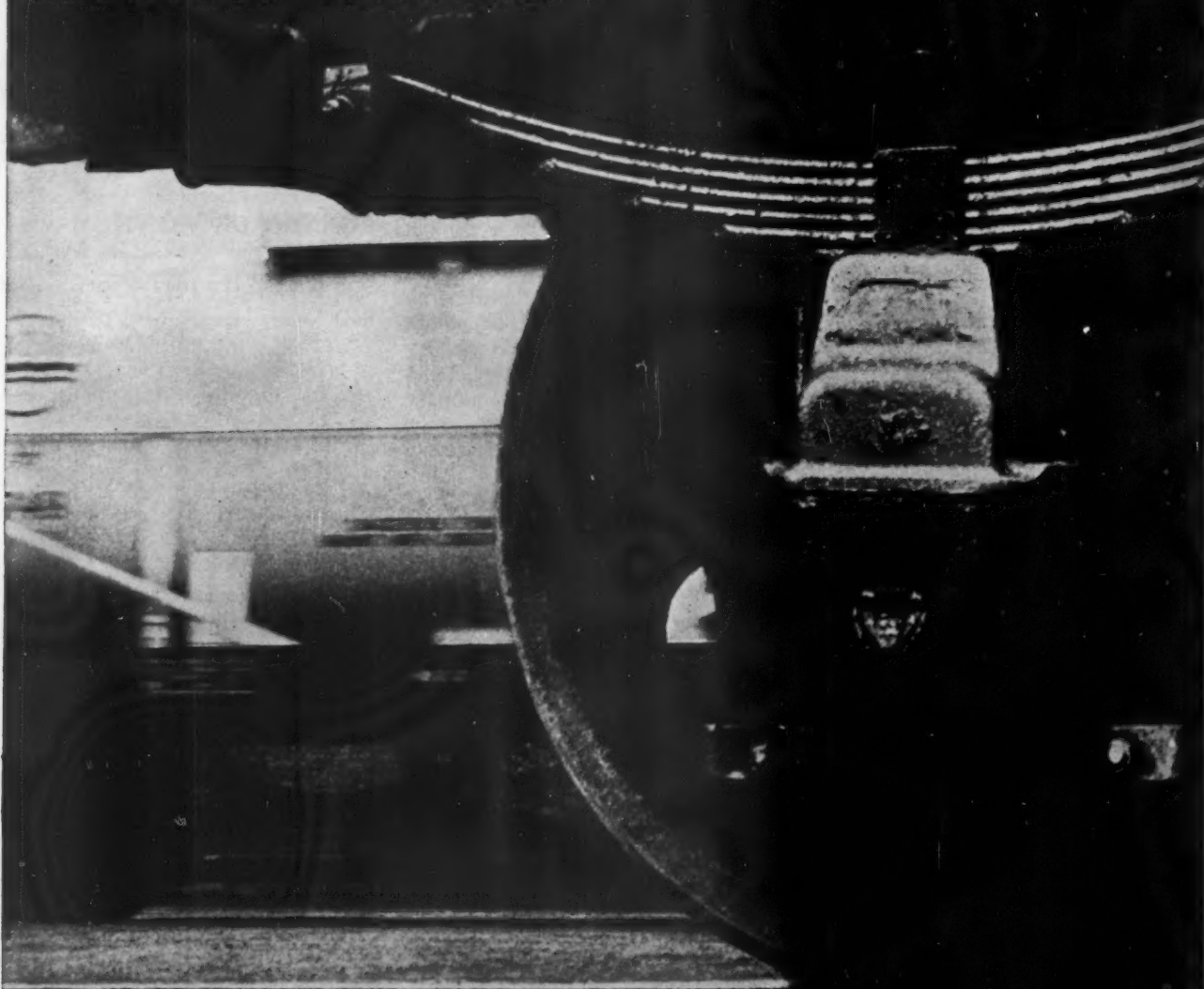
Mechanical Products Corporation, 1716 W. Hubbard St., Chicago, Ill.

### TUBE FITTINGS

Utilizing the characteristics of the O-Ring Seal, in which seal and grip are separate, a wide range of fittings is offered in special shapes, sizes, finishes and materials. Separate seal and grip design is cited as solving many tube fitting problems because there is no damage to the tube through soldering, flaring, threading



# 'Arcton' travels



'Arcton' goes everywhere. It's not only Britain's best-selling refrigerant, but the choice of discerning users in Europe, India, Pakistan, South Africa, South America and as far afield as Hong Kong and Australia.

The reason is simple: for uniform high quality and constant performance the 'Arcton' range is unbeaten. There's an 'Arcton' chlorofluoro-hydrocarbon refrigerant for every use.

Literature and information are available on request.



GENERAL  
CHEMICALS  
DIVISION

Imperial Chemical Industries Ltd., London, England.



Contact your nearest agent for further information about 'Arcton' chlorofluorohydrocarbons.

**AUSTRALIA**  
I.C.I. of A. & N. Z. Ltd., P.O. Box 1911,  
Melbourne, C.2.

**BELGIUM**  
I.C.I. (Belgium) S.A., 32 Rue Edmond Tollenaere,  
Brussels, 2.

**CHILE**  
Cia Imperial de Industrias Químicas de Chile S.A.  
Com. e Ind., Casilla 1357, Santiago.

**COLOMBIA**  
John Simon & Cia. Limitada, Calle 14 No. 12-50,  
Oficina 815, Bogotá.  
Rodrigo Agudelo O, Edif. Garces, Avenida  
Colombia Calle 11, Oficina No. 303, Cali.  
Walter Bridge & Co. Ltd., Edificio "Jenaro  
Gutierrez", Calle Colombia No. 47-98, Medellín.  
Tracy & Compania S.A., Carrera 44, No. 36-29,  
Barranquilla.

**GHANA**  
I.C.I. (Export) Ltd., P.O. Box 104, Tema.

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**ITALY**  
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Ese. Av. Universidad, Mexico 12, D.F.

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**PANAMA**  
Agencias W. H. Doel S.A., Apartado 322,  
29-15 Avenida 11.

**PERU**  
Imperial Chemical Industries S.A. Peruana,  
Com. e Ind., Casilla 1688, Lima.

**PHILIPPINES**  
Wise & Co. Inc., P.O. Box 458, Manila.

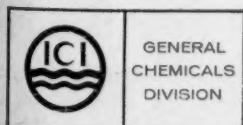
**SOUTH AFRICA**  
I.C.I. (South Africa) Ltd., P.O. Box 11270,  
Johannesburg.

**SPAIN**  
Sociedad Anonima Azamon, Apartado 711,  
Paseo de la Castellana No. 20, Madrid, 1.

**SWEDEN**  
Helger Andreasen, A/B, Storgatan 7, Orebro.

**URUGUAY**  
Industrias Químicas Uruguayas "Duperiel",  
Avda. General Rondeau 2050, Montevideo.

**VENEZUELA**  
H. Kern & Co., S.A., Apartado 1567, Edificio Kern,  
Av. Ppal. Los Cortijos de Lourdes, Caracas.

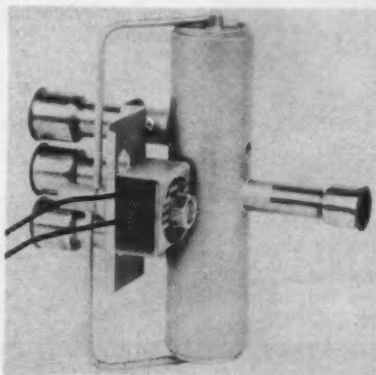


or scoring. All parts are reusable. Fittings are available in cadmium plated steel, black phosphate, stainless steel and other materials.

Lenz Company, 3301 Klepinger Rd., Dayton 1, Ohio.

## FOUR-WAY VALVES

All-metal, four-way reversing valves for control of refrigerants in reverse



cycle air conditioning systems, heat pumps and hot gas defrost applica-

tions are offered. Designated KV44, the new units feature hermetic valves with full ported, poppet-type pilot valve and plastics encapsulated coils. Pilot is mounted rigidly to the main valve, permitting a shift of the main slide valve with both low and high system pressures. Maximum operating pressure differential and safe working pressure is 500 psi and minimum change-over pressure differential is 40 psi.

General Controls Company, 801 Allen Ave., Glendale 1, Calif.

## WALL FURNACE

Introduction of the new 60FA Panel-ray provides two-speed operation in a compact, 60,000 Btu/hr, forced-air wall furnace design. Installed flush to the wall or recessed between ordinary stud spaces, the furnace delivers heat from the front only or with short through-the-wall ducts to register grilles in adjacent rooms. Single and two-speed models are offered; the single-speed unit operates on a standard thermostatically controlled heat

## BUT TIME RAN OUT

(Continued from page 71)

promotion, and that industry support will be forthcoming, it will appoint an ad hoc project group which first will plan the program and raise the project funds and then administer the work. Each such project group will report directly to the R/T Committee and the activity will be continued as long as there is work to be done and the financial support is available.

Projects financed largely or wholly by Society funds will be initiated and administered in a similar way although project proposals and requests for support may come from cooperating institutions and these may be acted upon by R/T Committee directly.

Fig. 1 shows diagrammatically how a research project might be handled under the new procedure.

Obviously, we are not going to make the transitions in programming, organization and project administration overnight. The present committee structure will probably be continued until the end of our fiscal year—July 1, 1961. However, in order to sustain the momentum of research in the Society to the greatest degree possible,

interim procedures and adjustments undoubtedly will be required.

I have dealt here with only the major problems we face. A number of other details must receive study and direction by R/T Committee, such as:

1. Classification and preservation of miscellaneous Laboratory data and files and transfer to New York;
2. Select a research organization;
3. Establish and staff the Research Office in New York and define its responsibilities;
4. Review and revise contract forms to cover projects with various types of cooperating institutions;
5. Develop suggested accounting procedures for monitoring research funds, etc.

I am writing this just before the Chicago meeting, during which a Research Symposium is scheduled. It is our hope that open discussion of the Society's research program and objectives will not only stimulate member interest but also suggest better approaches to some of our problems. Likewise, any member reading this article who wishes to forward comments or suggestions can be assured of our grateful attention to his thoughts.

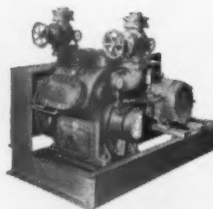
## Summer Cooling... Winter Curling and Skating... all with ONE refrigeration system



Main entrance to Prudhomme's Garden Centre Motor Hotel in Vineland, Ontario. This exciting summer and winter playground spot uses Vilter refrigeration to good advantage.

Two 6-cyl. Vilter VMC belt-driven compressors provide refrigeration at Prudhomme's for summer air conditioning and winter curling.

The Garden Centre Theatre becomes a regulation six-sheet curling rink during the winter months. The Vilter system is designed to produce ideal curling ice at the lowest possible power cost.



Year 'round use of your refrigeration capacity is sound business and enables maximum profit to be realized from your investment.

An excellent example of the year-round utilization of refrigeration is Prudhomme's Garden Centre Motor Hotel in Vineland, Ontario, along the Queen Elizabeth Way. At this famous motel, recreation center and convention headquarters, Vilter refrigeration plays an important role in keeping guests happy.

During the summer months, refrigeration is required to air condition the 180-room motel, one of Canada's largest, and an 1100-seat summer stock theatre which draws large crowds to see outstanding stock productions of Broadway plays. In winter months, the same equipment builds ice surfaces for a 90' x 180' outdoor ice skating rink and a regulation six-sheet curling rink. The summer stock theatre building is used to house the curling rink with either a seating structure installed or plastic piping laid for the curling rink, depending upon the season.

Vilter equipment installed at Prudhomme's includes two 6-cylinder VMC compressors and a 24" x 20' shell and tube condenser.

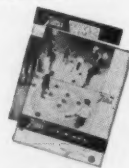
Vilter has had many years of experience in recommending and building refrigeration systems for air conditioning and ice rinks. This know-how, plus the use of dependable economical-to-operate Vilter equipment, can also mean a satisfying installation for you. Why not see your nearest Vilter representative today?

**Sold and Installed by VILTER DISTRIBUTOR**  
**J. L. Wilson and Sons, Limited, Toronto, Ontario, Canada**



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Manufacturing Company**  
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Air Units • Ammonia and Freon  
Compressors • Booster Compressors  
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Valves and Fittings • Pakice and  
Polarflake Ice machines.



Write for helpful  
bulletins to  
**The Vilter Manufacturing  
Company, Dept. AR-614**  
2217 South First Street  
Milwaukee 7, Wisconsin

cycle and the double can be set manually for either normal or high operation.

Day & Night Manufacturing Company, P. O. Box 2222, La Puente, California.

### 3-CU FT CHAMBER

Model HASU-100-3-HC, a new environmental unit, incorporates high and low temperatures, altitude and humidity in one compact three-cu ft chamber. Temperatures from -100 to



500 F are cited as being controlled accurately to  $\pm 2$  F to provide a thermal capacity of 1200 Btu/hr at -100 F, pull-down from ambient to -100 F or warmup to 500 F in one hr. Altitudes of 100,000 and 150,000 ft are attained in 30 min and one hr, respectively. Humidity range is from 20 to 95% ( $\pm 5\%$ ) at temperatures between 35 and 200 F.

Equipment supplied in the chamber area includes a recessed fin coil evaporator, adjustable shelves, pressurized amphenol fittings and interior illumination.

**Cincinnati Sub Zero Products, 3932  
Reading Rd., Cincinnati 29, Ohio.**

### CUTTER-DISPENSER

For Thred-Tape pipe joint sealer, an improved clean cutting Positive Feed dispenser has been developed. Consisting of a transparent plastics case (shown), upon which a chrome-plated cutting and dispensing mechanism is mounted, the unit shows the amount of tape remaining. Tape is fed through the cutter by a knurled cylinder, mounted for thumb operation. When the de-

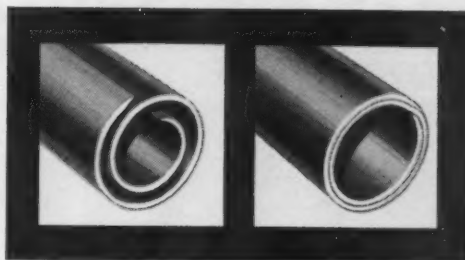


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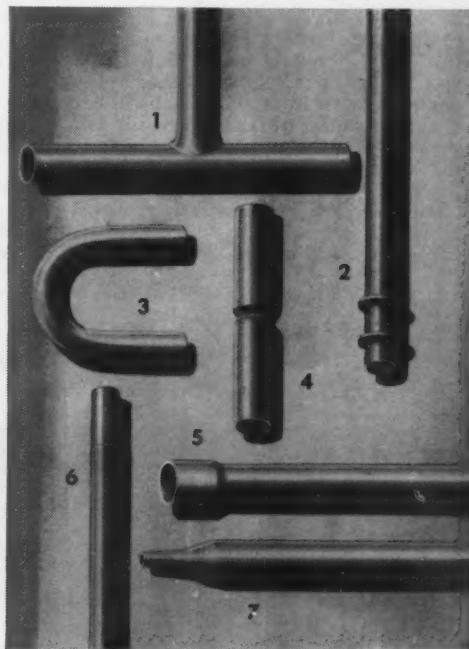


If you use tubing that requires fabricating—anything from simple bends to special forming and machining—it will pay you to talk to Bundy®. Many of these mass-fabricating operations have been developed by Bundy especially for refrigeration use, and one of them may solve a difficult tubing problem for you. Your parts will be mass-fabricated from Bundyweld, the leakproof *double-walled* steel tubing. Bundyweld has long been the safety standard of the refrigeration industry and is covered by ASTM 254; and Govt. Specification MIL-T-3520, Type III. Can Bundy help you? Phone, write, or wire: Bundy Tubing Company, Detroit 14, Michigan.

**BUNDY TUBING COMPANY • DETROIT 14, MICH. • WINCHESTER, KY. • HOMETOWN, PA.**  
World's largest producer of refrigeration tubing. Affiliated plants in Australia, Brazil, England, France, Germany, Italy, Japan.



Bundyweld, double-walled from a single copper-plated steel strip, is metallurgically bonded through 360° of wall contact. It is lightweight and easily fabricated... has remarkably high bursting and fatigue strengths. Sizes available up to 5/8" O. D.



Small-diameter tubing components mass-fabricated by Bundy may be the answer to your design problem. The Bundyweld tubing shown above is: (1) saddled and soldered, (2) double-beaded, (3) bent to minimum radius, (4) grooved, (5) expanded, (6) precision-ground, (7) swaged.

**BUNDYWELD®  
TUBING**





## DRY and CLEAN AIR at the RIGHT TEMPERATURE

**For Processes or Material Demanding Precise Control, Use Niagara Liquid Absorbent Air Conditioning.**

*This compact method, giving high capacity in small space, removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the air.*

*Most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a pre-*

*cise result, and always. Niagara machines using liquid contact means of drying air have given over 20 years of service. The apparatus is simple, parts are accessible, controls are trustworthy.*

*Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions...no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.*

*Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.*

*Write for Bulletins 112 and 131 and complete information on your air conditioning problem.*

### NIAGARA BLOWER COMPANY

Dept. RE-4, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U.S. and Canada

## THE ULTIMATE IN THE COMPRESSION REFRIGERATION CYCLE\*

**THIS IS ANOTHER CYCLE CENTER,** factory assembled and on its way to a 150 ton poultry freezing plant.

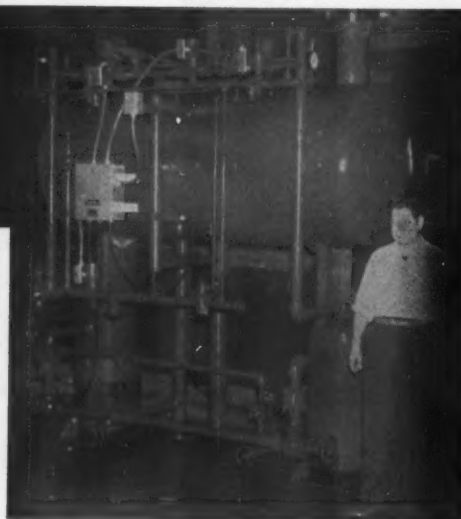
**What will it do?\***

It will provide liquid overfeed to the evaporators, catch the excess liquid and recirculate it to the evaporators, with these results:

- FULL COMPRESSOR PROTECTION AGAINST SLUGS
- PEAK COIL AND COMPRESSOR EFFICIENCIES
- SUB COOLED LIQUID FEED AT CONSTANT PRESSURE THE YEAR AROUND
- PRACTICALLY UNLIMITED RATE OF LIQUID FEED AT ABSOLUTELY NO POWER COST
- NO MECHANICAL PUMPS
- NO FLASH GAS IN LIQUID LINES

**\* NOT JUST A LIQUID RETURN UNIT.**

Available for any refrigerant, in capacities from 10 to 1,000 tons and more. Factory assembly is optional.



- SAFE, AUTOMATIC PLANT OPERATION
- OIL SEPARATION, ANY REFRIGERANT
- HIGHER SUCTION PRESSURES
- LARGE POWER SAVINGS
- LARGE SAVINGS IN FIRST COST ON NEW PLANTS. FOR EXAMPLE, THE RECEIVER IS NOT REQUIRED AND SURGE DRUMS ARE ELIMINATED.
- AUTOMATIC HOT GAS DEFROSTING AT MINIMUM COST

ASK FOR BULLETIN CC-2

**J. E. Watkins Co.**

307 LAKE STREET, MAYWOOD, ILLINOIS

## NEW PRODUCTS

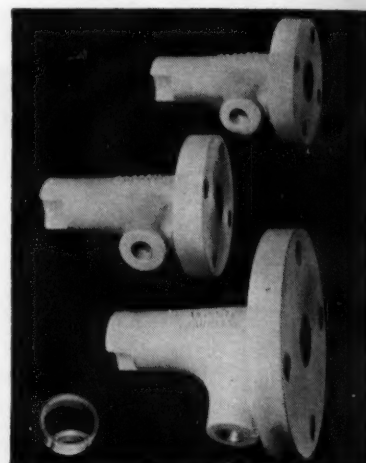
(Continued from page 110)

sired amount of tape is exposed, pressure on the feed cylinder actuates the steel cutter.

Crane Packing Company, 6400 Oakton St., Morton Grove, Ill.

### WELD NECK FLANGES

Three types of weld neck Traceline flanges are available in sizes, 1, 1½, 2, 3, 4 and 6 in. for installation of integral aluminum steam traced pipe shown in the insert. Top flange pic-



tured has standard 150-psi drilling. At the bottom is an adapter flange with diam and bolt circle one size larger than standard for the pipe size, to fit steam traced valves. The jump-trace flange shown in the middle has a straight-through product line for flanging sections of pipe together, using a jumper for steam passage around the flanges. An overlapping sole plate closes the trace section. Alcast Fittings, One Yale Ave., Claymont, Del.

### WIRE TESTER

For testing wire and cable under temperature conditions from -100 to 80 F (± 2 F), Model WU-100-24 has a capacity of 1000 Btu/hr at -100 F and a pulldown of ambient to -100 F in one hr. Measuring 24 in. wide, 26 in. deep and 72 in. high, the specially designed chamber is penetrated by a self-supporting cone-step mandrel which provides for testing on 2, 3, 4½ and 6-in. diam. The mandrel may be used on the side or the back wall of the chamber and its pillow-block construction will accommodate a test load of ½ ton. Current requirements of the power pack are 230 volt, 60 cycle, one-phase.

Cincinnati Sub Zero Products, 3932 Reading Rd., Cincinnati 29, Ohio.

# Low Water Cut-offs on Hot Water Boilers?

## ...the industry has given the answer

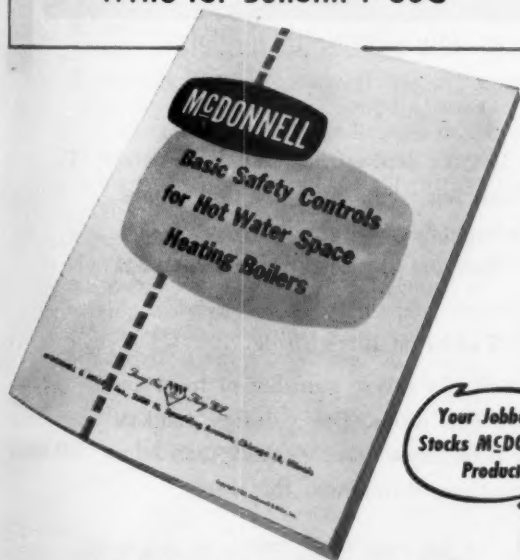
Yes, the answer has come from the field . . . from the engineers, contractors and manufacturers. They have seen the logic of installing a water level control on hot water space heating boilers . . . a low water cut-off, or—for even greater precaution—a feeder cut-off combination.

We knew it was a good idea. Expected it to grow and grow. But frankly we have been surprised at how rapidly the heating industry has taken hold of water level control as a logical team mate for an ASME pressure relief valve.

In fact, many local codes now require a low water cut-off, or feeder cut-off combination, on hot water boilers installed in places of public occupancy—including multiple dwelling units.

Notice the diagrams of recommended installations opposite. For more detailed discussion get this booklet that tells the whole story: "Basic Safety Controls for Hot Water Space Heating Boilers."

**The What-Why-How  
in eight interesting pages**  
Write for Bulletin P-30C



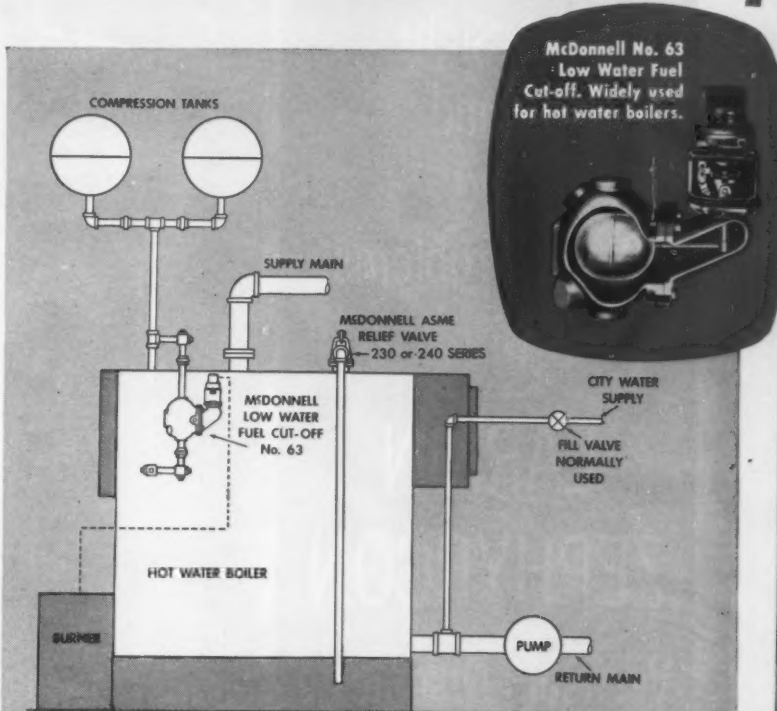
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Stocks McDONNELL  
Products

**McDONNELL & MILLER, Inc.**  
3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One  Thing Well

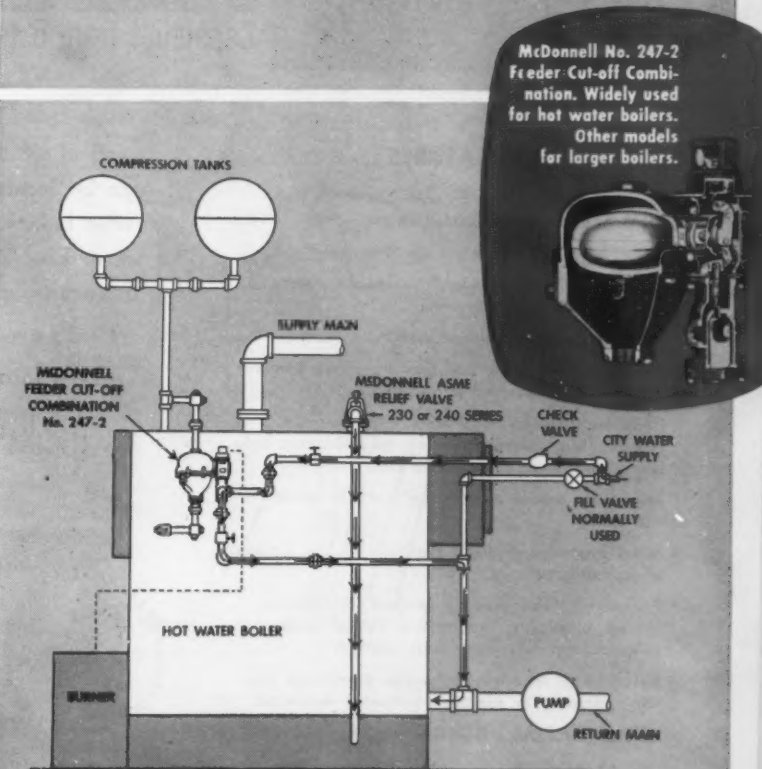
# McDONNELL

*Water Level Controls*



McDonnell No. 63  
Low Water Fuel  
Cut-off. Widely used  
for hot water boilers.

**1** The essential low water control for a hot water boiler. A McDonnell Low Water Cut-off located above lowest permissible water level; also McDonnell A.S.M.E. Pressure Relief Valve.

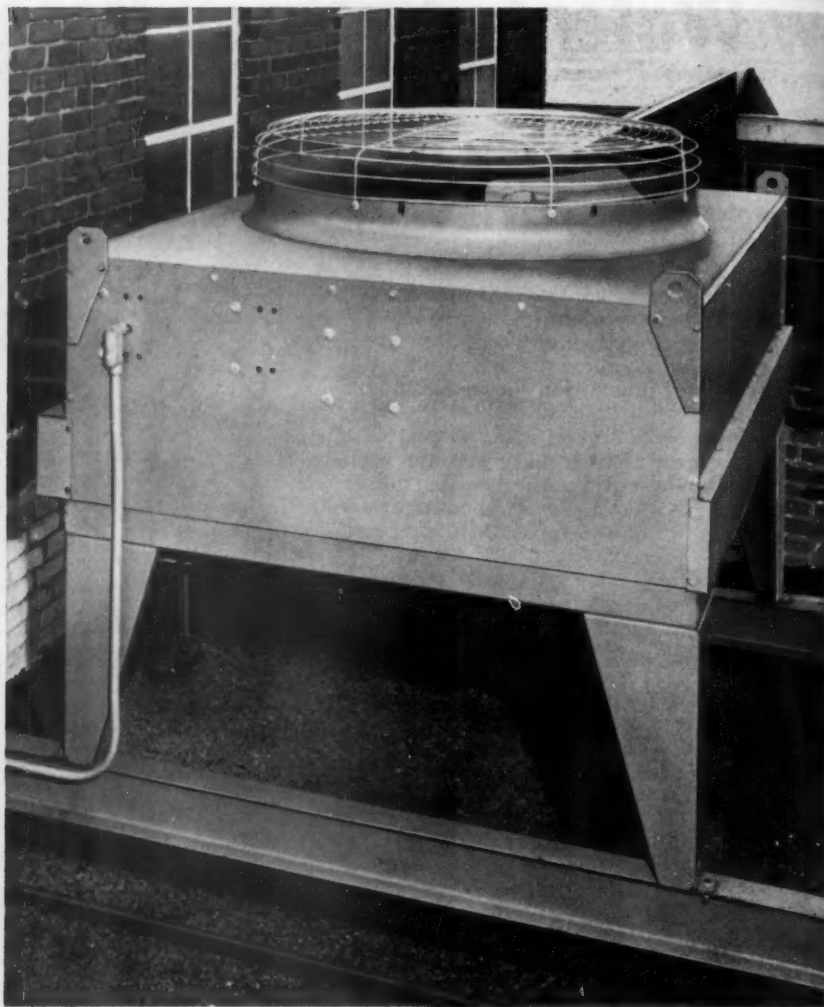


McDonnell No. 247-2  
Feeder Cut-off Combination. Widely used  
for hot water boilers.  
Other models  
for larger boilers.

**2** The safest and most complete control for a hot water boiler. Offers a combination of mechanical and electrical safeguards which is today's best and most complete answer. A McDonnell combination Boiler Water Feeder and Low Water Cut-off; also McDonnell A.S.M.E. Pressure Relief Valve.



End Sight,  
Sound  
and  
Water Problems  
with  
**LARKIN**  
**ZEPHYRCON**  
Vertical Discharge  
Air-Cooled  
Condensers



Capacities from 5 to 60 tons—low silhouette models

**OUTSTANDING FEATURES**

- Patented LARKIN cross-fin coil—aluminum fins bonded to staggered copper tubes.
- Circuiting designed for counter-flow operation.
- Low-speed fans, dynamically balanced, assure top efficiency, quiet operation.
- Each fan has two matched v-belts.
- Fan shaft mounted in ball bearing pillow blocks—permanently lubricated and sealed.
- Heavy-duty motors, drip-proof, NEMA frame, ball bearing, mounted securely on adjustable base within unit housing, protected from weather.
- Removable service door—easy access to motor and belts.
- Metal prepared through five-stage Oakite Crysoat phosphating process.
- Primed with epoxy resin; finished with thermo-setting, plastic-base enamel—a triazine resin. Long-lasting, water-and-alkali-resistant.
- Safety-spiral wire guard heavily zinc-plated and Iridite-dipped for maximum corrosion resistance.
- Multiple circuiting available when specified.

Vertical air discharge LARKIN Zephyrcons, BFC-V Models, can be located anywhere regardless of prevailing winds. Noise is kept to a minimum because air discharge is skyward. Low silhouette does not detract from the general appearance of a building.

Heavy eye-bolts on all units facilitate lifting.

These units are built to take severe punishment from the elements in all climate conditions. Basic design LARKIN Zephyrcon air-cooled condensers have proved successful in thousands of installations throughout the world.



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or see your wholesaler





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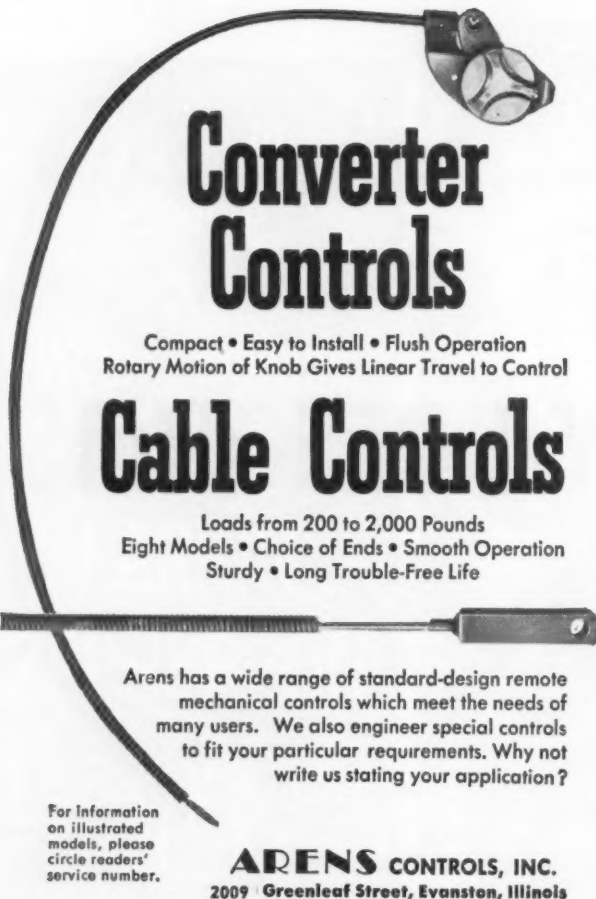
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# Converter Controls

Compact • Easy to Install • Flush Operation  
Rotary Motion of Knob Gives Linear Travel to Control

# Cable Controls

Loads from 200 to 2,000 Pounds  
Eight Models • Choice of Ends • Smooth Operation  
Sturdy • Long Trouble-Free Life

Arens has a wide range of standard-design remote mechanical controls which meet the needs of many users. We also engineer special controls to fit your particular requirements. Why not write us stating your application?

For Information on illustrated models, please circle readers' service number.

**ARENS CONTROLS, INC.**  
2009 Greenleaf Street, Evanston, Illinois



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**YOU NAME IT!** There are dozens of variables in size, style, application, mounting, chart range, actuation, manual or electric drive, tubing lengths, and pen systems.

One thing is sure. Weksler engineered recording instruments for temperature, pressure, humidity, and time-of-operation will meet every requirement. You name it! We'll produce it... but good!

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Indicating, Recording, and Controlling Instruments for Temperature, Pressure and Humidity

## Applications

### AIR CONDITIONED FACILITIES FOR BASEBALL TRAINING CAMP

Air conditioned facilities for minor league baseball players affiliated with the San Francisco Giants are being constructed on a 640-acre site near Casa Grande, Ariz. A Carrier absorption refrigerating machine with a cooling capacity of 150 ton will send chilled water through underground pipes to air handling units in the camp's administration building and its four dormitories.

### CONVERTED BOILER PLANT HEATS OFFICE BUILDING

Operating costs of Manhattan's 56-year-old Sheraton-Whitehall Building were reduced by discontinuing outside steam service and converting an old boiler plant to provide winter heating for the 733,000 sq ft of office space. Accurate control of temperature posed a major problem in conversion of the unused boiler plant to heating service, solved by use of three eight-in. Spence Engineering Company temperature regulators, each having high and low temperature pilots. Automatic controls were provided for individual room convectors fans to reduce costs of night-time and weekend heating of offices.

First step in modernization of the heating system called for reactivation of three 450-hp, oil-burning, low-pressure steam boilers, each capable of supplying 15,000 lb/hr of ten-lb steam. Two Patterson-Kelly heat exchangers, rated for 7000 gpm peak load at 135 F, handle winter heating. Cooling is provided by two 1145-ton Trane Centravac centrifugal chillers. Water for heating or cooling is circulated to 2000 individual room convectors at 3500 gpm by two 150-hp centrifugal pumps. Depending on the size of the office, convectors were installed with capacities of 200, 300, 400 and 600 cfm. Three eight-in. Spence E-2 temperature regulators are supplied by a low-pressure steam line from the boilers. Each regulator is operated by two T134 temperature pilots controlled by vapor-tension thermostats with bulbs installed in the outlet side of the heat exchangers. A high temperature pilot controls at 135 F and a low temperature pilot at 100 F.

### AUTOMATED POST OFFICE USES HIGH TEMPERATURE HOT WATER

Opened recently in Providence, R.I., an automated post office is housed in a 300 by 420-ft building. In line with a trend in heating large, sprawling build-



# Engineered to

## RETAIN YOUR PRODUCT LEADERSHIP

### *Alco Designed* **CONTOUR POWER ASSEMBLY**

Increases power element life as much as 10 times over other designs by reducing extreme flexing of the diaphragm. Standard construction on all ALCO "T" Series and "HTL" Series.

### *Alco Designed* **RAPID RESPONSE REMOTE BULB AND WELL**

- Reduces danger of floodback
- Extra-quick closing response
- More efficient control over wider range of operating conditions
- Economical to install in package units
- Available on all Alco Gas Charged Valves when specified

### *Alco Designed...*

for easy capacity changes or cleaning without breaking connections or removing valve from line.

Simply ... loosen **2** bolts ... lift out cage ... clean and replace.

## **ALCO** T-SERIES \*THERMO EXPANSION VALVES

- Refrigerants: FREON-12 from 1/2 ton to 50 tons, FREON-22 from 1 ton to 80 tons, CARRENE-7 from 3/4 ton to 60 tons, PROPANE from 1 ton to 88 tons • 2 BODY DESIGNS meet every requirement—STRAIGHT THRU CONNECTIONS or RIGHT ANGLE CONNECTIONS • WIDE VARIETY OF CONNECTIONS (Outlets to match distributor requirements) • EXTERNAL or INTERNAL EQUALIZER • EXTERNAL or INTERNAL SUPERHEAT ADJUSTMENT • TIGHT SEATING ... STAINLESS STEEL STEM AND SEAT • CORROSION-RESISTANT MATERIALS • MOUNT IN ANY POSITION
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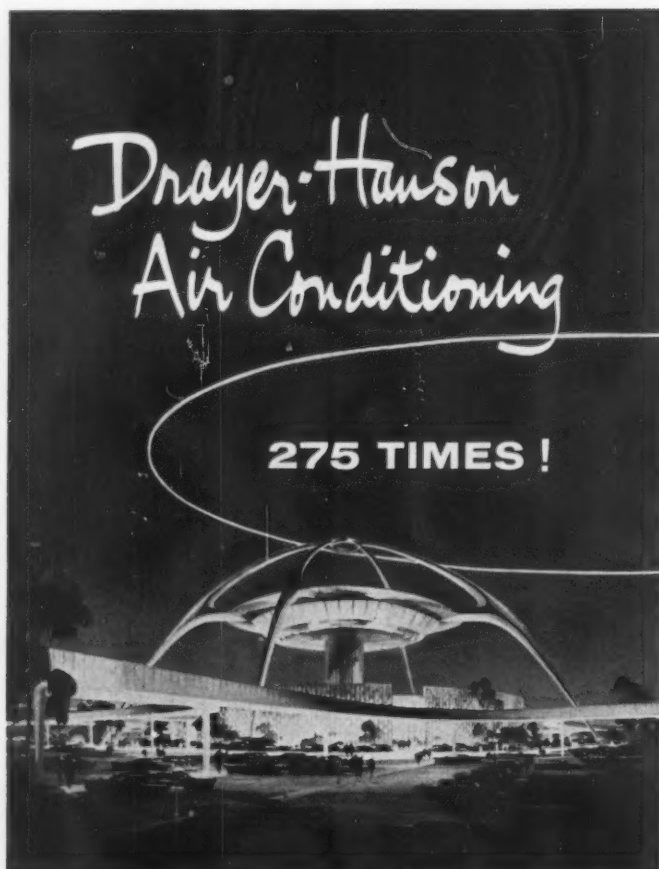
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# *drayer-hanson*

DIVISION OF  
**HI-PRESS AIR CONDITIONING OF AMERICA, INC.**  
3301 Medford Street, Los Angeles 63, California  
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ings, a high temperature hot water system was installed, utilizing two Cleaver-Brooks CB 500-hp boilers to supply forced circulation hot water to a loop piping network.

Located in the Lubritorium, a separate building for trucks and powerhouse, the central heating plant supplies water at 230 to 245 F. Individual areas in the system take the desired amount of high temperature hot water from the loop for use in zone heating, direct radiation and unit heaters. Return water temperature is 180 to 200 F.

## **97,100 SQ FT COOLING COIL SURFACE TO SERVE CARGO-PASSENGER SHIPS**

Each of three Grace Line cargo-passenger ships will be equipped with 27 coils, with housing and drain pans, to refrigerate a total of 560,000 cu ft of cargo space. 530,000 cu ft, cooled by 25 of the Dunham-Bush units, will be utilized to carry bananas at 53 F or fresh fruits and vegetables at 35 F. The other 30,000 cu ft, handled by two units, will be used to carry frozen meats or shrimp at 0 F.

Total refrigeration load for each of the vessels when carrying bananas is 582 ton during pull down and 258 ton during holding. Total cooling coil surface is 97,100 sq ft per ship. Air delivery to all the units will be through duct work from fans installed in central fan rooms.

## **EXPOSITION HALL HEATED, COOLED WITH 60 ZONE SYSTEMS**

McCormick Place, Chicago's ten-acre exposition hall, contains 320,000 sq ft of exhibition space, two theaters, a restaurant, a cafeteria, an art gallery and many meeting rooms. Solution of the heating, ventilating and air conditioning problem presented by varying load conditions dictated use of individual heating and cooling systems for each major area. In all, 60 separate air conditioning systems were planned for the installation.

Heart of this complex is a mechanical center on the lower level of the building, which consists of two areas: a boiler and a refrigeration room. From this center, low pressure steam is supplied to the air conditioning units for heating and 42-F chilled water for cooling. On the floor above is a 36-ft electronic control board with schematic floor plans which pinpoint the various temperature zones. Connected with this board are temperature sensing elements in 140 different locations.

Four Cleaver-Brooks CB boilers (shown) of 600 hp each, automatically supply steam to meet the varying demands. In addition to heating the building, the boilers are used for heating incoming air, reheating cooled air from the air conditioning system and for domestic hot water needs. Contained in the refrigeration room are three centrifugal machines with 4000 ton of refrigeration capacity. Condensing water is piped from the lake to the refrigeration units.



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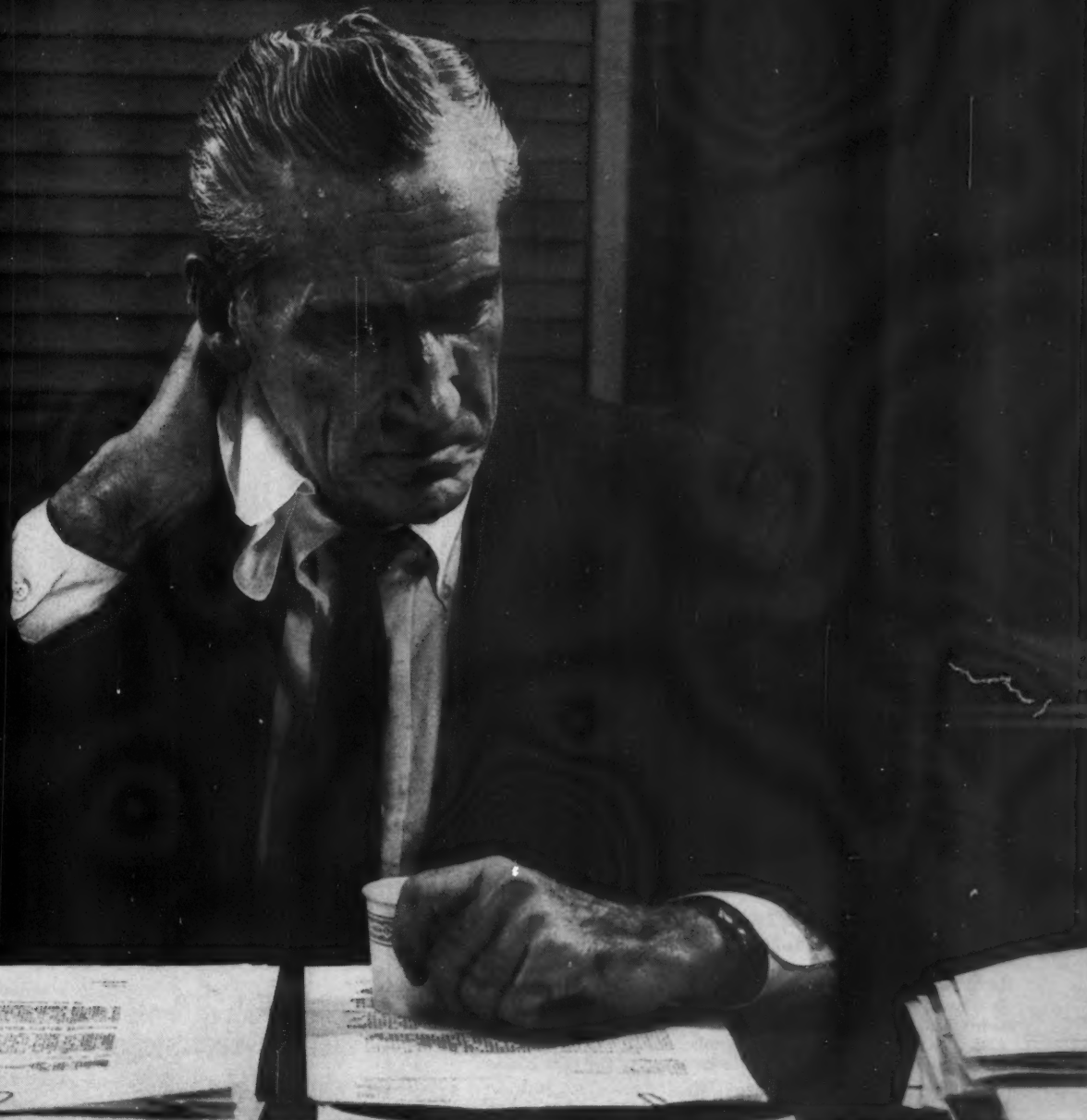
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## He's sweating out an algae problem

No wonder he's sweating—his office air conditioning broke down on the first hot day—and algae and slime were to blame. Right now he is trying to figure out how much the loss of efficiency and lowered output of more than 100 office workers is going to cost him.

Air conditioning systems can have some algae and still perform reasonably well under normal conditions. But when the temperature goes up, algae and slime reduce water flow and heat transfer, causing a shutdown.

Don't let this happen to your customers. Regular treatment with one of the Calgon algaecides will keep refrigeration and air conditioning systems free of algae and slime.

You have a choice of two types of algaecides. Calgon® Biocide RP is a very potent liquid which has *Reserve Power* for longer lasting protection and is most effective against green algae. Calgon Algaecide comes in pellet form and is especially effective against slime bacteria growths.

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tomer... and a full line of products backed by the Calgon name... all these are at your service. Call on Calgon for help on any water problem.

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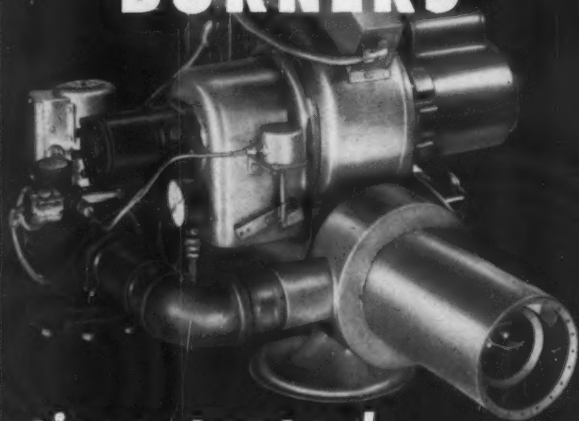


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Unique design of burner head forces gas and air into combustion chamber with cyclonic turbulence. This gives compact flame configuration with resulting high heat release, facilitating firing of equipment normally presenting difficult combustion problems.

Accurate combustion air control with either fuel eliminates need for induced draft fan or tall chimney. Fixed firing rate, two-stage or fully modulating gas control systems are available. Dual gas/oil burners are designed for quick manual or automatic fuel changeover. Low-fire start and pre- and post-purge are optional. Totally enclosed control panel is standard. Panel lights indicate when controls are energized.

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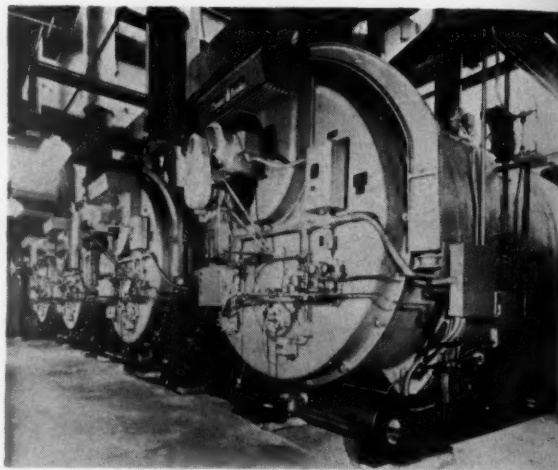
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In Canada:

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In the main exhibition area, 22 high velocity fan systems, each with its own heating and cooling coils, are located in truss space above the exhibition floor. Each unit has individual exhaust outlets, supply and return fans and fresh air intakes. Air for the meeting rooms is supplied from fan rooms at 70,000 cfm. Mixing boxes for each room provide individual temperature control. The 5000-seat theater, built on two



levels, is air conditioned by two 75,000-cfm air handling units, with low velocity fans used to minimize sound. Used along the corridors is a hot water radiant system. Heat exchangers convert steam from the boilers for this system.

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